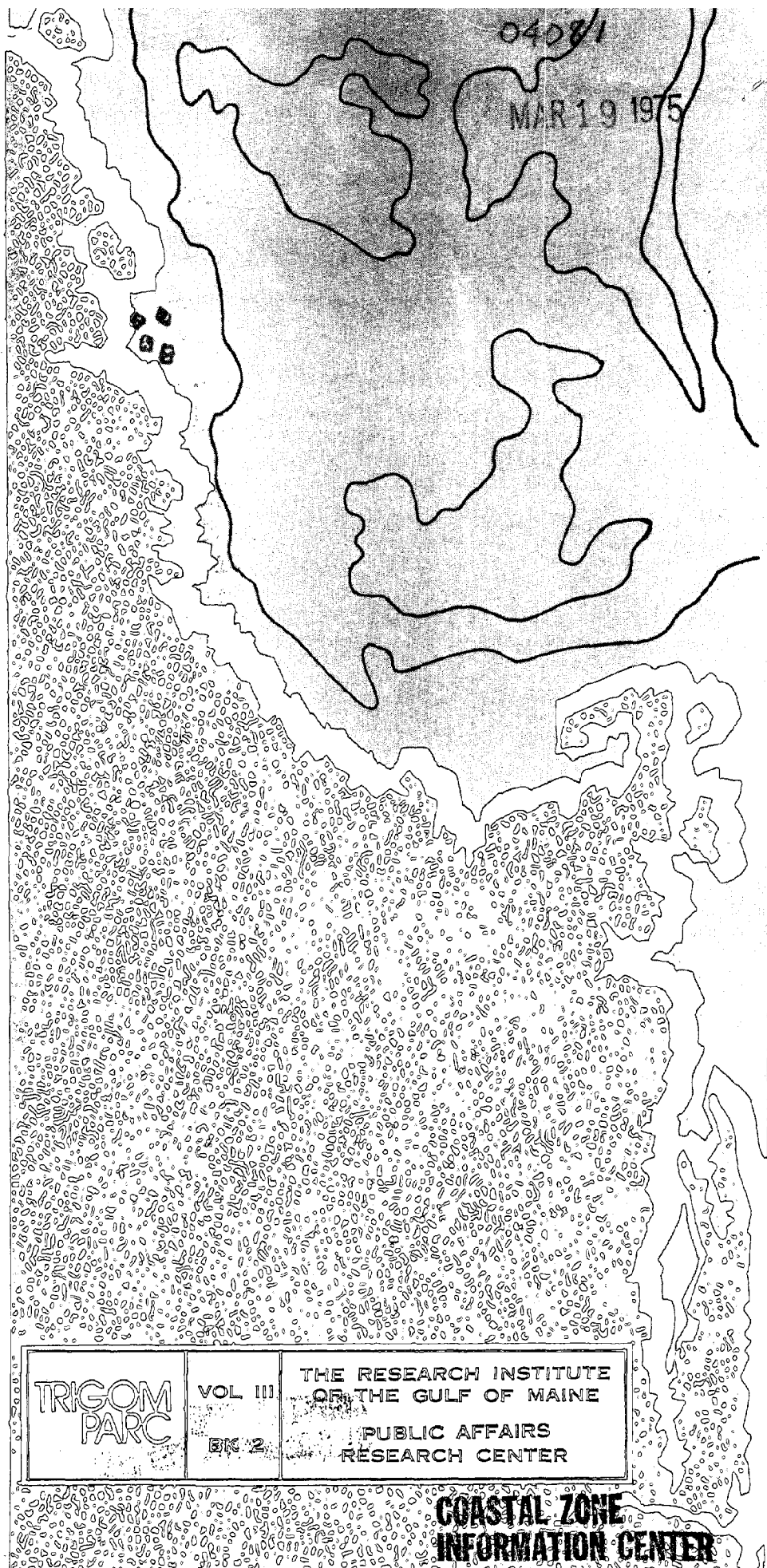


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# Socio-Economic and Environmental Inventory of the North Atlantic Region Sandy Hook to Bay of Fundy

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**A Socio-Economic and Environmental  
Inventory  
of the  
North Atlantic Region**

including the Outer Continental Shelf and adjacent  
waters from Sandy Hook, New Jersey, to Bay of Fundy

VOLUME III

Book 2

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## **Appendix**

# **D Bibliography**

At the time of submission of this report Appendix D, the bibliography, is still in preparation and will be included early in 1975 in a separate Book as the last part of Volume Three. This part will also include a detailed index to all chapters.

#### APPENDIX D BIBLIOGRAPHY

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## Appendix

# **E Areal Extent of Marine Habitats**

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## APPENDIX E AREAL EXTENT OF MARINE HABITATS

### E.1. INTRODUCTION

#### E.1.1 OBJECTIVE

This section is a compilation of existing statistical and mapped data which pertain to the location and size of coastal habitats (rocky and sandy shores, saltmarsh, worm-clam flats, oyster-mussel reefs, subtidal shellfish beds, and saltponds). In keeping with the systems ecology approach used in this report, the statistical information has been organized into tables by habitat and then by state, and when possible, broken down by county and town. (See Summary of Marine Habitat Measurements, Tables E-1 through E-31). Mapped data from numerous sources has been standardized onto American Geographical Society base maps, scale 1:250,000. (See Figures E-1a,b, E-2a,b, E-3a,b, E-4a,b). A discussion has been included in the following pages (section E.2) to clarify the methods and definitions used by the various data sources. At the end of the appendix is a list of references used.

#### E.1.2 APPROACH

Information for maps and measurements of habitats was gathered from federal, regional, state, and local agencies in the form of published and unpublished reports and maps, and notes taken during phone conversations and personal visits. As data were compiled, it became evident that there are gaps and inconsistencies within and between the states, partially accounted for by differences in funding available for environmental surveys, the definitions and methods used by various researchers (see following section E.2), and the emphasis placed on certain habitats by economic, recreational, or legal pressure. Some measurements differed by as much as a factor of ten. All statistical data regardless of how discrepant, has been included in the tables in order to give an idea of the range of measurements possible. The assumptions, definitions and methods that account for the discrepancies are explained in the corresponding section of the discussion.

On the map when data conflicted, the source judged to be most recent, detailed, and in accord with the habitat definitions used by this report was chosen. There are sections of the coast for which no data could be found in spite of extensive searching. On the map these blank spots are indistinguishable from those reaches which truly do not have any of the habitat in question. An example is Massachusetts' saltmarshes, for which mapped data were available only for eleven selected estuaries (Mass. Dept. of Natural Resources, monograph series 1966-1973). However, there are saltmarshes in the omitted stretches of coast, as can be seen by referring to Table E-11. Because the tables and maps are complementary, they should be used in conjunction with

one another in order to gain a more accurate idea of the extent and location of the various habitats.

## E.2. DISCUSSION OF MARINE HABITAT MEASUREMENTS

### E.2.1 SHORELINE LENGTH

Before discussing the various studies on shoreline measurement, it should be noted that there can be no one accurate measure of shoreline length, because the results depend on the scale of map used (shoreline length increasing with increased detail of the map) and the degree of inclusion of estuarine and riverbank mileage. When rivers and estuaries are included, cut-off points must be decided, and this can be on the basis of salinity, tidal effect, the location of a bridge or other landmark, or where, on a map, the river outline becomes a single, rather than double line. Hence, a wide variety of measurements for the same coastal reach may result.

The following discussion describes the surveys summarized in Tables E-1 through E-8.

#### TOTAL SHORELINE - NORTH ATLANTIC REGION

Two national surveys of coastline length supply consistent, if discrepant, data throughout the study region. The National Shoreline Survey (NSS) (U.S. Army Engineer Div., 1971) presents a rough total mileage figure based on a compilation of existing measurements from agencies, authorities, and conservation groups. The estimate is general and does not take into account many coastal irregularities. The second survey, by National Ocean Survey (NOS), National Oceanic and Atmospheric Administration, has defined "tidal shoreline" to include "outer coast, island, sounds, bays, and rivers and creeks to the head of tidewater or to a point where tidal waters narrow to a width of 100 feet." Measurements were made in 1939-40 on the largest scale charts then available. These estimates are believed to be more indicative of the amount of shore open to the ocean's impact.

#### Total Shoreline by State

Maine: (See Table E-2). The only complete coastal survey done in the State of Maine, in addition to previously mentioned national surveys, was by Reed and D'Andrea (1973, draft report). The definition of coast is similar to that of the National Ocean Survey except with respect to rivers. River mileage was included to the point on the map where the river outline became a single line. The Kennebec River estuary was included up to the northern end of Merrymeeting Bay, and the Penobscot up to Bucksport. Measurements were taken on 7.5' U.S. Coast Guard Survey Charts (scale 1:40,000). The total mileage was found to be 4,099.

The figure of 2,500 miles quoted by Maine Wetlands Inventory (Maine Department of Inland Fisheries and Game, 1972) is probably attributable to the National Shoreline Study.

The Maine Coastal Planning figures (Maine Office of State Planning, 1974) unfortunately are not complete, since the survey is presently being conducted, and therefore, cannot be fairly compared to Reed and D'Andrea's data which is also tabulated by county. The Coastal Planning figures run lower - it is unknown whether this is due to their methodology or the incompleteness of the project.

Islands account for much of Maine's shoreline measurement. According to the Maine Coastal Island Registry, (Caldwell, 1974), created by the State Legislature in 1973 to inventory the islands and establish ownership, there are 3,344 islands and exposed ledges. By county, there are 736 islands in Washington, 664 in Hancock, 30 in Waldo, 718 in Knox, 341 in Lincoln, 245 in Sagadahoc, 496 in Cumberland, and 114 in York.

New Hampshire: (See Table E-3). No survey by the state is known by either the New Hampshire Department of Resources and Economic Development, the New Hampshire Port Authority or the Department of Fish and Game; therefore, the only estimates are from the two national studies, National Shoreline Study (U.S. Army Engineer Division, 1971) and National Ocean Survey (1971).

Massachusetts: (See Table E-4). Two studies other than NSS (U.S. Army Engineer Division, 1971) and NOS (1971) list mileage for the Massachusetts coast. The Economic Impact of Marine-Oriented Activities (Rorholm, Lampe, Marshall, and Farrell, 1967) pertains only to the southern coastal counties. Measurements were taken from Coast and Geodetic Survey Charts, and Geological Survey Charts, the scale of which was not given. Ocean, bay, harbor, and tidal rivers were followed; but "detailed shoreline of coastal ponds and marshy areas (were) not." The Statewide Comprehensive Outdoor Recreational Plan (SCORP) (Department of Natural Resources, Division of Conservation Service, 1973), provides a total coastline mileage figure larger than any of the other estimates. The source of SCORP's estimate is not explained in its text.

Rhode Island: (See Table E-5). Rhode Island's coastline, deeply indented to form Narragansett Bay, posed a measurement problem, judging by the range of estimates found - from 340 to 2,793 miles. The lowest estimate, by NSS (U.S. Army Engineer Division, 1971) includes the outer extremities of Narragansett Bay and Block Island in addition to the ocean-fronting shoreline. Of the 340 miles, 150 are in the bay, 174 are along the southern shore from the western passage of Narragansett Bay to Connecticut, and 16 are on Block Island. The methodology of NOS (1971) is more inclusive, as described in the Shoreline introduction, (see Section E.2-1), and presents a greater total than does NSS. The Report of Governors' Committee on the Coastal Zone (Technical Committee, 1970) measured "total saltwater shoreline;" but does

not further define its salinity limit in the report. The most detailed measurement is provided by the Economic Impact of Marine-Oriented Activities (Rorholm, et al, 1967) by its breakdown into frontage on ocean, sound, harbor, bay, and tidal rivers. The ten-fold difference between this study's results and these of NOS is surprising, since both were done on the smallest scale U.S. Coast and Geodetic Survey Charts available, and the definition of what to include seem similar. Perhaps the charts available to NOS in 1949 were not of such a small scale as now available; or perhaps the "tidal river" included by the Economic Impact Study, extends farther than the NOS cut-off of "head of tidewater" or "point where tidal waters narrow to a width of 100 feet".

Connecticut: (See Table E-6). Three sources estimated Connecticut's shoreline as about 250 miles. The NSS (U.S. Army Engineer Division, 1971) includes bays, other tidal estuaries, and 20 miles of Fishers Island, New York. Murphy (personal communication), Connecticut Department of Environmental Protection, interprets this to mean, "reflect(ing) coastline frontage directly on the Sound," and derives this information from the NSS figure. Approximately the same figure was quoted by Mr. Bates, Department of Environmental Protection, Parks and Recreation. This estimate of 250 miles seems to be accepted by state officials. The NOS, a more detailed survey, presents a much larger figure. Tri-State Regional Planning Commission of New York (1973) measured almost straight across the coastline to arrive at the minimum figure of 150 miles.

New York: (See Table E-7). For New York, the NOS (1971) mileage estimate is most likely the most accurate. The NSS (U.S. Army Engineer Division, 1971) figure does not account for the northern half of Staten Island, and for part of East River and upper New York Bay - from Throgs Neck at the western end of Land Island Sound, along the East River, past Manhattan, to the narrows between Staten Island and Brooklyn. These omissions account for the smaller estimate. As for the Tri-State study, this group's method seems to be to measure the gross outline of the land, rather than the detail of indentation and promontories - and thus, their figure, as it was for Connecticut, is low.

New Jersey: (See Table E-8). No discussion is relevant for this short segment.

#### E.2.2 ROCKY SHORES

This habitat has been surveyed and mapped by the National Ocean Survey, formerly Coast and Geodetic Survey, (Coast and Geodetic Survey charts 200,300, and 1,200 series; and Small Craft Nautical Charts), but no tabular data indicating linear extent have been compiled. The National Shoreline Study (NSS) (U.S. Army Engineer Division, 1971) made gross estimates of the percent of the coastline which is rocky north of Cape

Ann, Massachusetts. These figures have been questioned, especially in Maine where according to the study, only 50 percent of the shoreline north of Portland is rocky. Some feel the figure should be greater than 90 percent. It has been assumed that the National Ocean Survey definition of rocky approximates that of this report (consolidated rock only). Figures E-1b, E-2b, E-3b, and E-4b, depict the extent of rocky shores in the study region.

### E.2.3 BEACHES

The effort to tabulate mileage for sandy shores was only partially successful due to the fact that existing shoreline surveys, in general, have not distinguished between rocky and sandy shores. Measurements are available, however, for "beach", and although this figure represents only a small part of the total sandy shore, it has been included for lack of better data. The definition of "beach" varies from source to source, from public recreational bathing beach to the more inclusive erodible shoreline. Therefore, the table for beach mileage can be used only as a general indication of the amount of sandy shore.

#### BEACH SURVEYS - TOTAL NORTH ATLANTIC

Two federal studies provided beach information for all the states - The National Shoreline Study (NSS), by the Army Engineer Division, (1971), the National Beach Inventory (NBI) (Brown, Moser, and Shenton, 1972), sponsored by the EPA. In NSS, beach refers to erodible coastline, in line with the Corps concern with erosion control. In effect, this definition nearly matches the one used in this report. The NSS maps reaches of erodible coastline and rocky shores, but due to the omission of shoreline detail, the map and the tabulated data are, for our purposes, an underestimate of both total and sandy shorelines.

The National Beach Inventory, in the form of an unpublished computer printout, is an incomplete survey of recreational bathing beaches which has, nevertheless, been included to indicate general locations of sandy habitats. The inventory was devised to record pollution conditions of recreational beaches during 1971. Questionnaires were mailed to state agencies, and in some cases followed up by phone calls and personal visits. Not all beaches were inventoried, and the printout sections for New Hampshire, New York, and New Jersey were unavailable.

#### Beach Surveys By State

No studies were found aside from the national studies previously discussed in any of the states in the study region with the exception of Massachusetts which follows.

Massachusetts: (See Table E-4). As part of the southeastern New England Study being conducted by the New England River Basins Commission, Professor William MacConnell, of the Department of Forestry and

and Wildlife Management at the University of Massachusetts, conducted a land use inventory, including beaches. MacConnell's beach acreage includes all the recreational area at a particular location - parking lots, bath houses, facilities, as well as the beach itself. Unfortunately, this definition differs too much for this information to be useful as a sandy shore habitat measurement, in spite of its being the most exacting study found. Also, the SCORP data collected by the Department of Natural Resources identified some 287 beaches. These data are not published but are on file at DNR.

#### E.2.4 SALT MARSHES

Saltmarsh inventories have been or are being done in each state of the study region as a result of wetlands protection act. The orientations, definitions and methods, which differ in each inventory are explained below.

Maine: (See Table E-9). Three studies have been reviewed which survey saltmarshes in Maine. First, the Maine Department of Inland Fish and Game has conducted a wetland inventory utilizing the wetlands classification system defined by Martin, Hotchkiss, Uhler, and Bourn (1953). Their wetlands types 16 and 18, defined below, approximate the salt-marsh habitat defined in this study:

- Type 16    Coastal Salt Meadow. Salt meadows border the landward side of salt marshes, or open water. The soil is always saturated during the growing season but is rarely inundated by tidal water. Indigenous plant species are salt meadow cordgrass (Spartina patens) and black rush: common three-square occurs in fresher areas. Salt meadows are of great importance to resident and wintering waterfowl, particularly when well interspersed with potholes and ditches. Such areas support large populations of amphipods, clams, and snails, and afford wildfowl an ample source of food.
- Type 18    Regularly Flooded Salt Marshes. Salt marshes occur most often along coastal bays. At average high tide during the growing season, the soil is covered with six inches or more of water. The predominant plant species is saltmarsh cordgrass (Spartina alterniflora). Open water areas often support wideon grass, eelgrass, and Sago pondweed. Feeding wildfowl use these wetlands heavily, as do herons, rails, other shore birds, fish, and shellfish.

It should be emphasized that each of these wetland types is generally found in conjunction with one or more of the other types. When classifying a wetland, the type which most closely identifies the greater portion (50 to 75 percent) of the area as it is delineated on the map has been selected.

The procedure for locating and mapping the wetlands is described in the Manual for Maine Wetlands Inventory (1972):

Stereoscopic inspection of aerial photographs and 15-minute topographic maps will continue to be the principal means of detecting wetlands. This inspection, however, can be complemented by a check of 7½-minute quadrangle maps (if available) and U.S. Coast Guard and Geodetic Survey Marine Charts. The marine charts are excellent sources of data for the true salt marshes and tidal flats. Both of these aids require enlarged acetate acreage scales; the marine charts should be supplemented by USCGS Chart 1, Nautical Symbols and Abbreviations...The configuration of the wetland on the photo may differ from that on the map; however, the photographs are generally more recent and provide a more accurate delineation of the actual wetland. Therefore, outline the area on the map as it appears on the photo.

Only areas larger than ten acres were included. Planimeter measurements were made on the photographs when available, and on USGS quadrangles when not.

A second study, conducted by the firm of Reed and D'Andrea (unpublished draft, 1973) included only those marshes larger than ten acres. Sources for this plan are 1972 unpublished maps by the U.S. Bureau of Sport Fisheries and Wildlife, and an unpublished paper to the Maine Audubon Society, 1972, by Sarah Redfield (A Working Paper; Maine Saltmarsh).

Finally, the wetlands and wildlife areas inventory by George C. Spinner (1969) uses the same wetlands classification system as the Maine Wetlands Inventory described above, but includes Type 15, characterized by salt grass (Distichlis spicata) with Type 16.

Data from these inventories are nearly in agreement with differences attributable to the described differences in classification schemes or methods.

New Hampshire: Tabular data has not been compiled by the New Hampshire State government as far as could be determined.

Massachusetts: (See Table E-11). The land use inventory by Professor William MacConnell, described previously, (See Section E-2.3 - Massachusetts), distinguishes three types of saltmarsh which have been combined in this report:

1. Tidal saltmarsh which is flood twice daily. Vegetation is primarily saltmarsh cordgrass.
2. Irregularly flooded saltmarsh, flooded at monthly high tides and during severe storms. Vegetation is primarily saltmarsh, cordgrass, saltgrass, and black rush.

3. Irregularly flooded salt meadow which has been ditched for mosquito control or for agricultural purposes.

In MacConnell's unpublished draft of April 1973, he states that wetlands will be delineated on 1:24,000 (1"=2,000') scale maps, and later transferred to SENE base maps 1:63,000 (1'=1 mile).

The Massachusetts Department of Natural Resources (Chesmore et al, 1971, 1972, 1973; Curley et al, 1972; Fiske et al, 1967, 1968; Jerome et al, 1965, 1968, 1969) conducted a shellfish survey in 11 selected estuarine areas, during which saltmarshes in the areas were measured. U.S. Coastal Charts (1:20,000 scale) and a dot grid overlay were used to compile acreages. There is no statement whether the marshes were delineated by new field work or by accepting the Chart's boundaries.

The wetlands classification used by Spinner, (1969), has already been described in a previous section (see E.2.4-Maine). For Massachusetts, the source was "1954 wetland surveys published by the U.S. Bureau of Sport Fisheries and Wildlife". Such data, 20 years old, probably include acreage since lost by dredging or filling.

Rhode Island: (See Table E-12). The Salt Water Marsh Inventory (1965), by the Rhode Island Department of Agriculture and Conservation was compiled in 1965 from aerial photographs supplemented by field research. According to John Cronin, Rhode Island Department of Natural Resources, the extent of marshes has not altered appreciably since the inventory.

The acreage estimated by Spinner, (1969) was computed from the 1954 U.S. Bureau of Sport Fisheries and Wildlife wetland surveys.

A project of measuring the state's saltmarshes is currently underway by the University of Rhode Island, Department of Oceanography, Coastal Resources Management Group. The survey is scheduled for completion by summer of 1974.

Areas mapped on Figure E-3a are the result of three sources: (1) efforts of Richard Sisson and Howard Russell, Jr., of the Connecticut Marine Fisheries Base in Wickford, Rhode Island; (2) a map from Hill and Shearin's Tidal Marshes of Connecticut and Rhode Island; and (3) the Salt Water Marsh Inventory by Rhode Island Department of Agriculture and Conservation.

Sisson and Russell, personally well acquainted with saltmarshes throughout the state as a result of shellfish management work, collaborated to indicate marshes on a base map of 1:250,000 scale. The outlines thus sketched in were not exact.

In Hill and Shearin's report (1970) marshes larger than 15 acres were sampled by borings to determine characteristics of thickness of peat, texture of underlying mineral layer, and salinity; and were then subse-

quently divided into deep, shallow, or very shallow coastal salt marsh, or brackish estuarine marsh. Classification was therefore based primarily on soil survey and salinity rather than vegetation, though indicator plants proved a useful tool for on-site identification. The marshes were mapped onto USGS 1:125,000 maps, and their boundaries estimated from 1965 aerial photographs supplemented by field reconnaissance in 1968 and 1969. Several fresh-water marshes influenced by coastal tides, along the Connecticut River between Haddam Neck and Hartford were omitted.

The Salt Water Marsh Inventory, described above as a statistical source, included a set of thirteen maps with marshes hatched in. The areas were slightly less inclusive than those from Hill et al (1970), perhaps a matter of difference of definition. When conflicting, data was chosen from Hill et al (1970),

Connecticut: (See Table E-13). All the estimates of Connecticut saltmarsh acreage are old, and none offer a breakdown by county, town, or marsh. Spinner compiled "saltmarshes" and "saltmeadows" (see E.2.4-Maine) from 1954 BSFW data, corrected by the Department of Inland Fish and Game. Tri-State Regional Planning Commission got their figure from a 1959 survey of "saline acres" - possibly from Spinner, judging by the closeness of the numbers. Odum's 1969 estimate was arrived at by applying a 55 percent intact/45 percent destroyed adjustment to a 1914 measurement of 23,360 acres of saltmarsh. The most recent, although only an estimate, was provided by Connecticut Department of Environmental Protection. According to James Murphy (personal communication, 1974), Connecticut has thoroughly described the nature of its saltmarshes, but because there has not been a need, no maps nor measurements have been made. Connecticut defines, by Public Act 132, a saltmarsh as follows:

"...tidal wetland means those areas which border on or lie beneath tidal waters, such as, but not limited to, banks, bogs, saltmarsh, swamps, meadows, flats, or other low lands subject to tidal action, including those areas now or formerly connected to tidal waters, and whose surface is at or below an elevation of one foot above local extreme high water, and upon which may grow or be capable of growing some, but not necessarily all, of the following: Spartina patens... (and other species)."

The map illustrated on Figure E-31 was taken from Tidal Marshes of Connecticut and Rhode Island (Hill et al, 1970) as mentioned above under Rhode Island.

New York: (See Table E-14). Six sources provided New York wetland data. Two of these inventoried Nassau and Suffolk Counties on Long Island, in detail; by town. Three other sources included more of New York but in less detail; one concentrated on Great South Bay, Long

Island.

O'Connor and Terry (1972) used the following method in their inventory of marine wetlands of Nassau and Suffolk Counties:

"Aerial photographs of Suffolk and Nassau Counties made in 1970 were used to locate wetlands and to estimate their areas. All aerial photos were at a scale of one inch to 400 feet (1:4,800). Generally, the area of each marsh was outlined on an aerial photograph while in the field. The boundaries of marshes were defined by the usually marked transition from tidal marsh vegetation to that of uplands or sandy beaches. Tidal creeks less than 50 feet (15m) wide were also included. Intertidal mudflats were not included as marsh area, making our marshland definition identical, insofar as can be determined, with the periodic Federal Government inventories of Long Island wetlands (U.S. Department of the Interior, 1965). The area of each marsh was measured by superimposing a grid of one-acre squares upon the marsh outlined on the aerial photograph. The precision of these measurements is probably within 5 percent of the true area, given consistently accurate scales in the aerial photographs.

"Essentially all Nassau and Suffolk County marine wetlands were observed by one or both of the authors during the summer and fall of 1971. Depending upon the size and accessibility of the wetland, from 15 minutes to two hours were spent in recording observations at each location."

The Long Island Marine Wetlands - Status, Value, and Preservation Potentials by the State Office of Planning Services, (1972) also measured just Nassau and Suffolk counties. This report includes salt and brackish wetlands of two types: (1) "the intertidal zone, the area covered at normal high tide by exposed at low tide, characterized by tidal flats and cordgrass marshes (*Spartina alterniflora*)"; and (2) "the zone of salt meadow, the area between normal high tide and peak lunar tides, characterized by meadows of salt hay (*Spartina patens*) and associated plants such as alkali grass (*Distichlis spicata*)". Acreage data was supplied by the State Department of Environmental Conservation. The numbers in the text do not agree completely with those in the table, although they are close. The text figures were occasionally preceded by the word "approximately", which could account for some rounding off; and, the table was headed Selected Marine Areas, implying that some marshes were left out. As can be seen, the acreage figures from the text section are generally larger.

Another study contracted by the Nassau Suffolk Regional Planning Board, Wetlands on Long Island, (Green, 1972), used figures from surveys conducted by the U.S. Fish and Wildlife Service in cooperation with the New York State Conservation Department from 1953 to 1964, to determine the extent of wetland destruction (Green, 1972). The survey, covering all of Long Island, though sketchily, included "fresh and saline coastal marsh-

lands of 40 acres or larger", valued from negligible to high as water-fowl habitat. Its range of study is thus somewhat different than that of our report.

The Tri-State Regional Planning Commission (New York, New Jersey, Connecticut) surveyed wetlands in its recent report, An Interim Management Guide for the Tri-State Coastal Zone (1973). It does not define wetland precisely; sources for the data table are "secondary data, from the latest available reports and briefings." Hence, its figures can be used only as rough approximations.

The National Estuary Study (U.S. Department of Interior, Fish and Wildlife Service, 1970) simply cites one figure for total acreage of Great South Bay on Long Island, which approximates data from two Nassau Suffolk Regional Planning reports.

Spinner (1969) contains estimates for New York which exceed those of other studies, possibly because some of the areas have been lost by dredge and fill since 1954, when data used in Spinner's work were collected.

Wetlands were mapped on Long Island (see Figure E-3a) from The Marine Wetlands of Nassau and Suffolk Counties (O'Connor et al, 1972). Data could not be found for the other counties.

New Jersey: (See Table E-15). As part of the effort to halt wetland destruction, New Jersey passed the Wetlands Act in 1970, appropriating funds for an extensive effort to map the salt marshes, using aerial infra-red photography to detect saltmarsh areas. Maps on a scale of 1 inch for 200 feet have been made but are too detailed a scale to be included in this report. Statistical data have also been compiled, and are available, along with the maps, from the Department of Environmental Protection.

#### E.2.5 WORM - CLAM FLATS

The extensive worm and clam flats due to large tidal range in the north diminish as one moves south with small tides. South of Cape Cod, the shellfish habitats that are found exposed at low tide to the north are found here subtidally. For this reason, the category of "worm-clam flats", though appropriate for Maine, is inaccurate for the southern states and has been changed to "shellfish beds". On the map, the line of demarcation between exposed flats and submerged beds has been made at Provincetown on Cape Cod. Although somewhat arbitrary, as the transition is gradual in reality, this is where the tidal range becomes small enough to leave shellfish areas submerged rather than exposed at low tide.

The distinction between "worm-clam flats" and "oyster-mussel reefs"

becomes arbitrary in southern regions for much the same reason. Along Maine's coast, the clams and worms inhabit expanses of intertidal mudflats, whereas the oysters and mussels grow on subtidal reefs farther offshore. In the Rhode Island, Connecticut, and New York area, however, all shellfish grow on the ocean floor, and are never exposed by tidal excursion.

As one moves from north to south, the frequency of some shellfish species decrease while others increase, due primarily to the temperature change. Soft-shell clams abound in Maine, New Hampshire, and Massachusetts, but dwindle further south. Inversely, oyster populations do not become important until Rhode Island and south. Quahaugs, bay scallops, and conchs also grow in warmer areas.

Generally, information on the mud flat habitat comes from shellfish surveys, and for a few areas, from waterfowl studies. For some states, mud flats are well delineated and tabulated; for others, only sketchy maps lacking acreage estimates are available.

#### SURVEYS BY STATE

Maine: (See Table E-16). Reed and D'Andrea (draft report, 1973) have listed mollusc areas by town for Maine, using unpublished maps revised in 1969, and a computer printout of acreages, both prepared by Maine Department of Marine Resources.

The Maine Wetlands Inventory by the Maine Department of Inland Fisheries and Game, (1972), follows the wetlands classification system of Martin, Hotchkiss, Uhler, and Bourn (1954), defining mud flats as follows:

Type 19 Sounds and Bays. This type consists primarily of mud flats laid bare at low tide and occurring along salt-water rivers, sounds, and bays. Vegetation, if present, may consist of eelgrass, widgeon grass, Sago pondweed, and muskgrasses. These tidal flats support large shellfish populations and are extremely important to wintering waterfowl populations.

The methodology used in this inventory is described previously from the Manual for Maine Wetlands Inventory (1972).

The data are qualified for the user by the Manual:

"(Because) tidal areas are subject to greater alterations than most wetlands...absolute accuracy in size and shape determinations are not always possible. Such determinations are affected by several factors: the data of photography, the phase of the tide, the quality and scale of photography, and the precision of the geodetic survey. It is important to know that a wetland exists and where; knowledge of the area's precise acreage is of secondary importance."

Mapped information (see Figure E-1a, E-2a) was obtained from the Maine Shellfish Resource Atlas at the Maine Department of Marine Resources. The Atlas, composed in 1966, is periodically revised to update the data. Soft-shelled clams are best documented, being the most abundant and economically valuable shellfish. Mussels receive little attention. The Atlas states:

"The scarcity of shellfish population records and the resulting methods used in collecting information for this atlas place obvious limitations on the data. However, this documentation of shellfish resources is a compilation of a vast amount of information which, like the resource, is dynamic and maybe subject to constant change.

"The most accurate source of shellfish data compiled in this atlas was gathered from records of actual surveys conducted by Maine Sea and Shore Fisheries personnel (now the Department of Marine Resources). Some of these data reflect recent shellfish conditions on the shores whereas some may be considered historical.

"The amount of data available from actual surveys is quite meager, and to obtain the relatively large amount remaining it was necessary to interview biologists and coastal wardens. The information this gathered may be quite limited in accuracy because of the variability in estimating the resources by different observers."

New Hampshire: (See Table E-17). Shellfish data for New Hampshire are scanty. The only source is personal communication from Dr. Barrett of New Hampshire Fish and Game Department. No mapped data could be found at the state government level, and statistical data are rough estimates from a variety of sources.

Massachusetts: (Clam Surveys) (See Table E-18). Massachusetts Department of Natural Resources conducted a shellfish survey of selected estuarine areas in the state, from 1964 through 1969, publishing the results in a series of monographs. Limited by time, the surveys were not extensive, but "adequate to provide reasonable estimates of the existing shellfish populations."

Areas were first grossly surveyed by biologists to determine relative productivity, indicated by the numbers of siphon holes on the flats, and then subdivided into flats accordingly. Cubic foot samples were then collected randomly over productive and non-productive flats, and screened to obtain a count of the shellfish. From Wellfleet Harbor on Cape Cod, north of the New Hampshire border, subtidal areas were sampled by scuba divers using a cubic foot steel frame, and, in the deepest areas using a bay scallop dredge.

Acreage figures for the shellfish areas were calculated by using a dot grid overlay on either Coastal Geodetic Survey Charts, scale 1:24,000 or 1:25,000, or USDA aerial photographs taken in 1952.

These data for Massachusetts must be regarded as both partial and approximate. Not all coastal areas were surveyed. The random sampling method has been challenged by Edward Wong, Natural Resource Officer, Environmental Protection Agency, Region I, Boston office, as producing misleading results. He proposed biased sampling, following the water currents and other physiographic indicators to outline areas of most probable productivity, and then sampling. This method perhaps does provide a better population estimate, however, for purposes of general habitat location, random sampling may provide as good results. No other source of shellfish flat data were found for Massachusetts, so comparisons cannot be made with the DNR's figures. Mapping was done on 1952 aerial photographs or 1:25,000 maps, by Massachusetts DNR, but because only selected estuaries were surveyed, the map is incomplete (See Figure E-2a).

#### E.2.6 SHELLFISH BEDS

Rhode Island: (See Table E-19). Information for this report was gathered during a visit to Richard Sisson and Howard Russell, Jr. at the Rhode Island Marine Fisheries Base in Wickford, Rhode Island, where unpublished data are on file. Both men are well acquainted with the shellfish areas in the state through their own experience regulating and extensively sampling shellfish areas, and through acquaintance with local fishermen. They indicated on a working map of 1:250,000 scale each shellfish area, then measured by planimeter on 1:40,000 quadrangles the acreage of each area. Due to the large scale of the maps, much detail could not be included.

A map of this information (Figure E-3a) used the following groupings: soft-shelled clams, quahaugs, conchs, and scallops were grouped together; oysters and mussels were grouped separately, in keeping with the distinction made under the Systems Ecology section of this report.

Connecticut: (See Table E-20). Tabular data available for Connecticut's shellfish habitats are not differentiated by species; therefore, oysters and mussels are grouped with clams, quahogs, and scallops in this section. In spite of the general term "shellfish", however, the predominant species is oysters, either natural or cultured. The state's index to leased and franchised shellfish grounds (Department of Agriculture, 1973-74) provides approximate acreages for the beds; these leased grounds are not necessarily congruent with truly productive beds. The leased grounds are potential culture sites and some are actively farmed while others are not always in use. In general then, the acres cited in the tabular data exceed those shown on the map.

The source for mapped shellfish areas is the Connecticut Shellfish Atlas, prepared by U.S. Department of Interior, Federal Water Pollution Control Administration (1970). For the Atlas, active productive

beds were separated from a general list of leased beds, by means of reviewing annually renewed licences, on the assumption that licences would be bought only if the leased area was being farmed. Shellfish dealers helped indicate where transplanted oysters were located, necessary because in the course of culturing oysters, they may be moved as many as two times to areas more suitable for growth or purification. No sampling research was conducted for the Atlas, so the validity of the information rests on the accuracy of the match between licensed areas and truly productive areas, and on the accuracy and honesty of dealers and fishermen.

New York: (See Table E-21). No statistical data could be located at the New York Department of Environmental Conservation. The maps from that same office are very rough, but all that was obtainable.

New Jersey: (See Table E-22). William Eisele of the New Jersey State Health Department, provided maps of shellfish area closures due to contamination, and an all-inclusive acreage estimate for the Raritan, Low, and Sandy Hook Bay complex. The maps do not indicate specific shellfish areas, only that the entire region is closed due to pollution.

#### E.2.7 MUSSEL - OYSTER REEFS

Maine: (See Table E-23). Maine's coastal waters are too cold to support many oysters, but there are mussel reefs, mostly in the two southern counties. These were located by the Maine Shellfish Resource Atlas, (Campbell, 1966), complemented by a few listings from Reed and D'Andrea (draft report, 1973). Because mussels are of low commercial value, complete and extensive surveys have not been done.

New Hampshire: (See Table E-24). No information in statistical form or maps was found during inquiries to the New Hampshire Department of Fish and Game, with the exception of mention that oysters live throughout Great Bay, (Barrett, 1974, personal communication).

Massachusetts: (See Table E-25). Oyster bed data were extracted from the Department of Natural Resources, Division of Marine Fisheries, Monograph Series, (1965-73) which covers only selected estuarine sites. For this reason, and because areal measurements have not been taken on those beds that have been designated, the map and tables are incomplete. With the exception of a few areas - Wellfleet Harbor and Westport River - oysters are not indigenous to the Massachusetts Coast, the water temperature being too low. The viability of planted populations is uncertain, so those beds indicated in the tables and on the map may no longer exist.

Rhode Island: (See Table E-26). The locations of oyster and mussel beds were provided by Richard Sisson and Howard Russell, Jr. of the Rhode Island Marine Fisheries Base at Wickford (personal communica-

tion, 1974). No published report was known which listed oyster beds or their measurements, but since the state is small enough to permit familiarity with its entire coastline, Sisson and Russell could indicate each oyster population, map its approximate size, and indicate whether it was natural or transplanted from another area. Mapped information is now available at the Wickford base, in unpublished files.

Only four acreage measurements were available. Longmeadows was measured by planimeter on a 1:40,000 CS chart by Russell; the three ponds were listed in Wright, Cheadle, and Palmatier's A Survey of Rhode Island's Salt and Brackish Water Ponds and Marshes (1949).

#### E.2.8 SALT PONDS

The salt pond habitat rarely occurs north of Cape Cod because the tidal range is too great to permit their development. (See Section 4.6.3). Only a few informational sources were found, and only for Massachusetts, Rhode Island, and Long Island, New York. More data may be available, but were not found.

Massachusetts: (See Table E-28). Saltponds have been given scant attention, and no studies were found on salt ponds exclusively. Since information came by way of chance references, the listing in Table E-27 is far from complete.

Rhode Island: (See Table E-28). Rhode Island's southern shore is scalloped by numerous salt ponds, most of them fronted by barrier beaches. Their saline nature, assumed from their appearance on the map, was verified by Sisson and Russell at Wickford, Rhode Island Marine Fisheries Base, (personal communication, 1970), and further corroboration and acreage measurements were supplied by Wright et al (1949). The one point of disagreement was on the nature of Trustom Pond. Sisson and Russell consider this to be a fresh pond, but Wright considers it a salt pond. This could be a dispute of definition, or it could be because of changes in the pond since Wright's 1949 survey due to changes in the barrier beach and breachway which separate the pond from the ocean.

Connecticut: (See Table E-29). No surveys were known to have been conducted by the Department of Environmental Protection.

New York: (See Table E-30). Great South Bay, considered a huge salt pond, is the only New York pond for which measurements were found. There are more ponds along Long Island's shore as can be seen on Figure 3a.

New Jersey: (See Table E-31). No information was gathered on New Jersey salt ponds.

#### E.2.9 PELAGIC

The pelagic habitat as defined by this report encompasses the estuarine, coastal, and Gulf water columns. No attempt has been made to measure the estuarine portion. The Gulf and coastal regions together occupy approximately 64,790 km<sup>2</sup> (see Phytoplankton, Chapter 8-1), of which 40 percent is the shallower and more productive areas of Georges Bank (25,920 km<sup>2</sup>) and Browns Bank (1,295 km<sup>2</sup>).

Table E-1

SUMMARY OF MARINE HABITAT MEASUREMENTS  
SHORELINE  
REGIONAL SUMMARY

State	Total Shoreline Miles	Beach Miles	Rocky Miles
Maine	2500 - 4099	21	
New Hampshire	40 - 131	17 - 25	10
Massachusetts	1200 - 2000	167 - 940	
Rhode Island	280 - 419	185	
Connecticut	150 - 618	87 - 145	51
New York	638 - 1850	331	
New Jersey	20	19	

Range includes all estimates available from various sources.

Table E-2 SUMMARY OF MARINE HABITAT MEASUREMENTS  
SHORELINE  
MAINE

Total Shoreline (miles)		Me. Coastal Planning <sup>a</sup>		Maine Wetlands <sup>c</sup>		Beaches (miles)		NBIf		NSS <sup>d</sup>	
County	Town	Reed <sup>b</sup>			NSS <sup>d</sup>	Town	#	Miles	Miles		
Washington						Jonesport	1	.30			
						NA	1	.57			
	Subtotal		971.6				2	.87			
Hancock	Verona Island	7.4				Lamoine	1				
	Brooklin	23.1				Bar Harbor	3	.24			
	Sedgwick	5.5				Seal Harbor	1				
	Stonington	17.1				Swans Island	1	.19			
	Deer Isle	45.5				NA	3	.09			
	Brooksville	38.9									
	Penobscot	7.9									
	Castine	9.8									
	Orland	3.0									
	18 towns missing						9	.59			
	Subtotal	158+	895.6								
Waldo	Isleboro	26.3				NA	2	.06			
	Prospect	.9									
	Stockton Spgs.	4.8									
	Searsport	1.4									
	Belfast	1.7									
	Northport	5.1					2	.06			
	Subtotal	40	122.6								

Table E-2 SUMMARY OF MARINE HABITAT MEASUREMENTS  
SHORELINE  
MAINE

Total Shoreline (miles)		Maine		Beaches (miles)	
County	Town	Me. Coastal Planning <sup>a</sup>	Reed <sup>b</sup> Wetlands <sup>c</sup>	NSS <sup>d</sup>	NBIF <sup>e</sup>
Knox	Crichaven	4.1			
	Isle au Haut	14.9			
	Matineus Pt.	6.4			
	North Haven	31.1			
	Vinalhaven	53.5			
	Camden	6.4			
	Rockport	10.5			
	Rockland	4.7			
	Owls Head	15.3			
	So. Thomaston	7.5			
	St. George	25.5			
	Thomaston	.6			
	Cushing	15.6			
	Friendship	21.3			
	Subtotal	218	315.0		5 .09
Lincoln	Waldoboro	7.8			
	Bremen	14.4			
	Bristol	22.0			
	So. Bristol	24.5			
	Damariscotta	3.3			
	Newcastle	2.1			
	Alna	.5			
	Southport	16.0			
	Boothbay Harbor	13.8			
	Boothbay	28.8			
	Edgecomb	11.2			
	Westport	32.7			
	Wiscasset	7.8			
	Subtotal	185	501.0		1 .04
					Damariscotta 1 .04

Table E-2 SUMMARY OF MARINE HABITAT MEASUREMENTS  
SHORELINE  
MAINE

Total Shoreline (miles)		Me. Coastal Planning <sup>a</sup>		Reed <sup>b</sup>		Maine Wetlands <sup>c</sup>		NSS <sup>d</sup>		Beaches (miles)		NBIF <sup>e</sup>		NSS <sup>d</sup>	
County	Town									Town	#	Miles		Miles	
Sagadahoc	Perkins Twp.	1.3								Popham Beach	1	.54			
	Georgetown	17.3								Georgetown	1	1.08			
	Woolwich	11.9								Knicker Kane	1	.07			
	Phillipsburg	31.7													
	Bath	5.2													
	W. Bath	18.9													
	Bowdoinham	.3													
	Subtotal	87			279.7						3	1.69			
Cumberland										Brunswick	1	.17			
										Freeport	1	.09			
										Yarmouth	1	.02			
										Cape Elizabeth	1	.76			
										Scarborough	1+	.85			
										?	2	.27			
	Subtotal				437.9						7+	2.16			
York										Old Orchard	1				
										Saco	2	1.61			
										Biddeford	1+	.09			
										Parsons Beach	1	.57			
										Goose Rocks	1	1.33			
										Kennebunk	1+	1.04			
										Wells	1+	4.00			
										Ogunquit	1+	1.33			
										York	1+	2.00			
										Kittery	1+	.95			
	Subtotal				230.7						13	15.72			
State Total					3754		2500	2500	3478		38	21.4		60	
					or										
					4099										

Table E-2 SUMMARY OF MARINE HABITAT MEASUREMENTS  
SHORELINE  
MAINE

- 
- a Maine Coastal Planning Unit, Maine Office of State Planning, 1974.
  - b Reed & D'Andrea, 1973.
  - c Maine Department of Inland Fisheries & Game, Manual for Maine Wetlands Inventory, 1972.
  - d U.S. Army Engineer Division, National Shoreline Study (NSS), 1971.
  - e National Ocean Survey (NOS), National Oceanic & Atmospheric Administration, 1971.
  - f Plessey Environmental Systems, National Beach Inventory (NBI), 1972.

Table E-28  
SUMMARY OF MARINE HABITAT MEASUREMENTS  
SHORELINE  
NEW HAMPSHIRE

TOTAL SHORELINE			BEACHES					ROCKY
County	NOS <sup>a</sup> Miles	NSS <sup>b</sup> Miles	NSS <sup>b</sup> Miles	NBI <sup>c</sup> #	Miles	#	Tucker <sup>d</sup> % Coast	Tucker <sup>d</sup> Miles
Rockingham	131	40	25	28	17.0	9	80-90%	10

a National Ocean Survey, National Oceanic & Atmospheric Administration, 1971.

b U.S. Army Engineer Division, 1971, National Shoreline Study (NSS).

c Plessey, 1972, National Beach Inventory (NB).

d Tucker, personal communications, 1974.

Table E-4  
SUMMARY OF MARINE HABITAT MEASUREMENTS  
SHORELINE  
MASSACHUSETTS

TOTAL SHORELINE (Miles)						BEACHES			
County	Town	NSS <sup>a</sup>	Eco. Imp. <sup>b</sup>	NOAA <sup>c</sup>	SCORP <sup>d</sup>				
						NBIE	NSS <sup>a</sup>	MacConnell	
						#	Miles	Miles	Acres
Essex	Salisbury					2	7.0		353
	Newburyport					-	---		56
	Newbury					1	7.0		164
	Rowley					-	---		40
	Essex					1	1.8		---
	Ipswich					1	3.7		464
	Rockport					1	0.5		57
	Gloucester					3	1.8		144
	Manchester					3	1.3		18
	Beverly					-	---		46
	Subtotal, NSS #30	75							
	Salem					1	0.5		4
	Marblehead					-	---		49
	Swampscott					2	1.6		45
	Nahant					-	---		91
	Lynn					3	1.9		---
Subtotal, County					18	27.1		1531	
Suffolk	Revere					2	2.4		79
	Winthrop					1	1.0		25
	Boston					8	2.9		95
	Subtotal, County					11	6.3		199
Norfolk	Quincy					2	2.3		---
	Weymouth					-	---		7
	Subtotal, NSS #29	100							
	Cohasset					2	0.6		7
Subtotal, County					4	2.0		14	

Table E-4  
SUMMARY OF MARINE HABITAT MEASUREMENTS  
SHORELINE  
MASSACHUSETTS

TOTAL SHORELINE (Miles)		BEACHES			
County	Town	Eco.		NBIE	MacConnell
		NSS <sup>a</sup>	Imp. <sup>b</sup> NOAA <sup>c</sup> SCORP <sup>d</sup>		
				# Miles	Miles Acres
Plymouth	Hingham			3	3.8 ---
	Hull			-	--- 118
	Scituate			5	1.2 198
	Marshfield			3	1.8 98
	Duxbury			-	--- 159
	Plymouth			2	1.3 563
	Kingston			1	NA ---
	Wareham			-	--- 152
	Marion			-	--- 93
	Mattapoisett			-	--- 40
	Subtotal, NSS #28	165			
	Subtotal, County	85.5		14	8.1 1421
Barnstable	Sandwich			1	1.1 255
	Barnstable			1	5.0 418
	Brewster			6	2.2 99
	Orleans			4	0.7 125
	Wellfleet			6	35.5 167
	Truro			1	0.5 339
	Provincetown			2	NA 271
	Chatham			3	24.0 492
	Hyannis			2	1.0 ---
	Harwich			1	0.9 114
	Dennis			2	1.5 160
	Eastham			9	4.2 ---
	Yarmouth			3	2.8 117
	Mashpee			1	1.5 98
	Falmouth			8	10.0 234
	Bourne			1	0.5 86
	Subtotal, County	240.3		51	91.4 2975
Bristol	Taunton			1	NA ---
	Fairhaven			1	0.2 95
	New Bedford			-	--- 18
	Dartmouth			2	5.8 165
	Westport			1	5.0 223
	Subtotal, NSS #27	370			
	Subtotal, County	55.8		5	11.0 501

Table E-4  
SUMMARY OF MARINE HABITAT MEASUREMENTS  
SHORELINE  
MASSACHUSETTS

TOTAL SHORELINE (Miles)						BEACHES			
County	Town	NSS <sup>a</sup>	Eco. Imp. <sup>b</sup>	NOAA <sup>c</sup>	SCORP <sup>d</sup>	#	MacConnell <sup>f</sup>		
							NBI <sup>e</sup>	NSS <sup>a</sup>	Acres
Dukes	Oak Bluffs					1	1.5		38
	Edgartown					5	11.4		419
	Tisbury					-	---		49
	W. Tisbury					-	---		173
	Chilmark					-	---		79
	Gayhead					1	1.5		70
	Gosnold					-	---		40
			99.8			7	14.4		868
Nantucket	Nantucket					1	6.0		1141
	Subtotal, NSS #26	230							
	Subtotal, County		72.9			1	6.0		1141
Total, State		1200	554.3*	1519	2000	111	167.2	940	8650
*Partial total, not all counties included.									

a U.S. Army Corps Division, 1971, National Shoreline Study (NSS).

b Rorholm et al., 1967. Economic Impact of Maine-Oriented Activities (Eco. Imp.).

c National Ocean Survey, National Oceanic & Atmospheric Administration, 1971.

d Mass. Office of Environmental Affairs, 1973.

e Plessey, 1972, National Beach Inventory (NBI).

f MacConnell, unpublished, 1972.

Table E-5  
SUMMARY OF MARINE HABITAT MEASUREMENTS  
SHORELINE  
RHODE ISLAND

TOTAL SHORELINE (Miles)										BEACHES				
County	Economic Impact Study <sup>a</sup>		NSSb		Gov's. Rept. c	Total Miles	Town	NBIC <sup>e</sup>	Rec. Mapf	NSSb	Gov's. Rept. c			
	Sound/ Harbor/ Ocean Bay	Tidal Rivers	Total Miles	Total Miles										
Newport	117.6		117.6				Little Compton Tiverton Island Park Portsmouth Middletown Newport Jamestown Prudence Island Subtotal	4 3 2 2 6 2 1 22	11 47 6 17 50 60 10 NA 201	4 3 2 1 3 5 3 22				
Bristol	21.4	8.1	29.5				Bristol Warren Barrington Subtotal	2 1 2 5	29 3 105 137	3 0 1 4				
Providence	2.1	14.2	16.3											
Kent	31.6	6.6	38.2				Warwick E. Greenwich Subtotal	2 1 3	NA 472 472	4 2 6				
Washington	39.5	31.0	7.2	77.7			N. Kingstown Narragansett Kingstown Charlestown Westerly Subtotal	3 16 1 2 8 30	8 370 5 4 175 562	2 14 7 2 10 35				
Total State	39.5	203.7	36.1	279.3	340	419	384	60	1372	67	185	70	60	

a Forholm et al., 1967. Economic Impact of Marine Oriented Activities.

b U. S. Army Corps of Engineers, 1971. National Shoreline Study (NSS).

c Rhode Island Technical Committee, 1970. Report to the Governor's Committee on the Coastal Zone.

d National Oceanic & Atmospheric Administration, 1971. National Ocean Survey (NOS).

e Plessey, 1972. National Beach Inventory (NBI).

f Rhode Island Department of Natural Resources. Rhode Island Recreation Map.

Table E-6  
SUMMARY OF MARINE HABITAT MEASUREMENTS  
SHORELINE  
CONNECTICUT

TOTAL SHORELINE (Miles)					BEACHES (Miles)			ROCKY (Miles)
NSS <sup>a</sup>	DEP <sup>b</sup>	Murphy <sup>c</sup>	Tri-Stated <sup>d</sup>	NOSE <sup>e</sup>	NSS <sup>a</sup>	DEP <sup>b</sup>	Murphy <sup>c</sup>	DEP <sup>b</sup>
270	258	250	150	618	145	87	142 "Beach" 55 "Potential Beach"	51

NOTE: Figures above apply to total Connecticut shoreline.

- a U.S. Army Corps Division, 1971, National Shoreline Study (NSS).
- b Dept. of Environmental Protection, Parks & Recreation, Mr. Bates, personal communications, 1974.
- c James Murphy, personal communications, 1974.
- d Tri-State Regional Planning Commission, 1973.
- e National Ocean Survey, National Oceanic & Atmospheric Administration, 1971.

TABLE E-7  
SUMMARY OF MARINE HABITAT MEASUREMENTS  
SHORELINE  
NEW YORK

TOTAL SHORELINE				BEACH
Region	NOS <sup>a</sup>	Tri-State <sup>b</sup>	NSS <sup>c</sup>	NSS <sup>c</sup>
	Miles	Miles	Miles	Miles
*The Harbor		256		
Sandy Hook - Raritan Bay			20	
Southern Staten Island			13	
Coney Island			5	
Rockaways			10	
Bronx, on L.I. Sound			18	
Subtotal, Region			66	
*Atlantic North		300		
Southern Long Island			108	
Barrier Beaches, South L.I.			172	
Eastern Forks			168	
Subtotal, Region			448	
*Long Island Sound		125		
Northern L.I., Suffolk Co.			87	
Northern L.I., Nassau Co.			16	
Westchester Co.			41	
Subtotal, Region			144	
Regional Totals		681	638	
State Totals	1850			331

\* NOTE: These 3 regions of the Tri-State study approximate, but do not necessarily equal, the sum of the NSS sub-regions listed below them.

a National Ocean Survey, National Oceanic & Atmospheric Administration, 1971.

b Tri-State Regional Planning Commission, 1973

c Army Corps of Engineers, 1971.

Table E-8  
SUMMARY OF MARINE HABITAT MEASUREMENTS  
SHORELINE  
NEW JERSEY

County	Town	Total Shoreline (Miles) NSS <sup>a</sup>	Beach (Miles) NSS <sup>a</sup>
Monmouth and Middlesex	Sandy Hook to Raritan River	20	19

Table E-9  
SUMMARY OF MARINE HABITAT MEASUREMENTS  
SALT MARSHES  
MAINE

County	Town	Reed <sup>a</sup>		Maine Wetlands <sup>b</sup>		Spinner <sup>c</sup>
		#	Acres	#	Acres	Acres
Washington	Perry	1	35			
	Dennysville	3	60			
	Lubec	6	133			
	Trescott	2	32			
	Cutler	2	54			
	Machiasport	2	43			
	Rogue Bluffs	1	153			
	Jonesport	2	49			
	Addison	4	589			
	Harrington	4	384			
	Millbridge	3	427			
	Steuben	4	126			
	Subtotal, County	34	2104	46	3424	
Hancock	Gouldsboro	2	157			
	Tremont	1	20			
	Cranberry Isles	1	33			
	Southwest Harbor	1	175			
	Mt. Desert	3	34			
	Bar Harbor	1	30			
	Franklin	4	112			
	Hancock	1	45			
	Lamoine	2	56			
	Stonington	2	26			
	Sedgewick	1	19			
	Brooksville	2	41			
	Penobscot	1	13			
	Subtotal, County	22	761	21	751	
Waldo	No Data					
	Subtotal, County			2	435	
Knox	Thomaston	1	273	1	273	
	Subtotal, County	1	273	1	273	
Lincoln	Newcastle	3	816			
	Edgecomb	1	24			
	Westport	1	81			
	Subtotal, County	5	931	5	931	

Table E-9  
SUMMARY OF MARINE HABITAT MEASUREMENTS  
SALT MARSHES  
MAINE

County	Town	Reed <sup>a</sup>		Maine Wetlands <sup>b</sup>		Spinner <sup>c</sup>
		#	Acres	#	Acres	Acres
Sagadahoc	Woolwich	2	95			
	Georgetown	6	1372			
	Arrowsic	3	207			
	Phipps	8	903			
	Subtotal, County	19	2577	16	2474	
Cumberland	Harpswell	1	50			
	Brunswick	8	317			
	Freeport	4	285			
	Yarmouth	1	21			
	Portland	2	123			
	Scarborough	2	3481			
	Subtotal, County	18	4277	21	4821	
York	Saco	4	304			
	Kennebunkport	5	800			
	Cape Porpoise	2	72			
	Kennebunk	1	207			
	Wells	2	1380			
	Ogunquit	1	345			
	York	3	470			
	Kittery	2	324			
	Subtotal, County	20	3902	28	4254	
Total, State		119	14824	140	17363	17633

<sup>a</sup> Reed & D'Andrea, 1973.

<sup>b</sup> Maine Department of Inland Fisheries & Game, 1972, Manual for Maine Wetlands Inventory.

<sup>c</sup> Spinner et al., 1969.

Table E-10  
SUMMARY OF MARINE HABITAT MEASUREMENTS  
SALT MARSHES  
NEW HAMPSHIRE

County	Town	#	Acres
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Table E-11  
SUMMARY OF MARINE HABITAT MEASUREMENTS  
SALT MARSHES  
MASSACHUSETTS

County	Town	MacConnell Acres <sup>a</sup>	Mass. DNR Acres <sup>b</sup>	Spinner Acres <sup>c</sup>
Essex	Salisbury	2527	4208	
	Newburyport	267		
	Newbury	4592	3267	
	Rowley	1981	1833	
	Ipswich	4007	4537	
	Essex	2376	2321	
	Rockport	49		
	Gloucester	878	847	
	Manchester	46		
	Beverly	42		
	Danvers	57		
	Salem	40		
	Marblehead	11		
	Peabody	7		
	Lynn	34	1269	
	Saugus	685		
	Subtotal, County	17599		
Middlesex	Everett	15		
	Subtotal, County	15		
Suffolk	Revere	506		
	Winthrop	35		
	Boston	343		
	Dorchester		363	
	Subtotal, County	884		
Norfolk	Milton	165		
	Quincy	481	209	
	Braintree	15		
	Weymouth	167		
	Cohasset	109		
	Subtotal, County	937		

Table E-11  
SUMMARY OF MARINE HABITAT MEASUREMENTS  
SALT MARSHES  
MASSACHUSETTS

County	Town	MacConnell Acres <sup>a</sup>	Mass. DNR Acres <sup>b</sup>	Spinner Acres <sup>c</sup>
Plymouth	Hull	14		
	Hingham	156		
	Scetuate	1225		
	Norwell	140		
	Marshfield	1977		
	Duxbury	986		
	Kingston	140		
	Plymouth	238		
	Wareham	883		
	Marion	445		
	Mattapoissett	498		
	Subtotal, County	6762		
Barnstable	Sandwich	1002		
	Barnstable	4023		
	Brewster	364		
	Orleans	614		
	Eastham	1278		
	Wellfleet	845	1117	
	Truro	169		
	Provincetown	473		
	Chatham	964	1203	
	Harwich	366		
	Dennis	925		
	Yarmouth	1212		
	Mashpee	258		
	Falmouth	512		
	Waquoit		6	
	Bourne	311		
	Subtotal, County	13316		
Dukes	Oak Bluffs	94		
	Edgartown	512		
	Tisbury	11		
	Chilmark	109		
	Gayhead	0		
	Gosnold	29		
	Subtotal, County	755		
Nantucket	Nantucket	708		
	Subtotal, County	708		

Table E-11  
SUMMARY OF MARINE HABITAT MEASUREMENTS  
SALT MARSHES  
MASSACHUSETTS

County	Town	MacConnell Acres <sup>a</sup>	Mass. DNR Acres <sup>b</sup>	Spinner Acres <sup>c</sup>
Bristol	Freetown	4		
	Acushnet	40		
	Fairhaven	675		
	Dartmouth	1149		
	Westport	940	775	
	Swansea	4		
	Somerset	29		
	Subtotal	2839		
Total, State		43815		42460

a MacConnell, 1972

b Massachusetts Department of Natural Resources, 1965-1973

c Spinner et al., 1969.

Table E-14  
SUMMARY OF MARINE HABITAT MEASUREMENTS  
SALT MARSHES  
NEW YORK

County	Town	Marine Wetlands <sup>a</sup>		L. I. Marine Wetlands <sup>b</sup>		Reg. Marine Res. Council <sup>c</sup>		Tri-Stated		NESE		Spinner <sup>f</sup>
		#	Acres	#	Acres	Tables	Text	Acres	#	Acres	Acres	
Nassau	N. Hempstead	4	131	5	110	110						
	Hempstead	5	7992	5	7992	7992						
	Oyster Bay	11	1401	10	1125	1125						
	Subtotal, County	20	9524	20	9227	9227		9495	NA	9485		
Suffolk	Huntington	17	577	15	599	620						
	Smithtown	3	675	3	521	520						
	Brookhaven	21+	2860	20	2223+	2750						
	Riverhead	7	284	2	253	253						
	Southold	27	1091	18	904	950+						
	(Fishers Island)	(7)	(62)									
	Shelter Island	8	279	5	148	150						
	Easthampton	11	1224	8	704	800						
	Southampton	23	1999	17	1542	1650						
	Islip	9	1414	12	1318	1300						
	Babylon	8+	2322	7	2525	2765						
	Subtotal, County	134	12725	112	10737	11758						

Nassau & Suffolk Great South Bay\*

\* Bay encompasses Southampton, Islip, and Babylon.

Table E-14  
SUMMARY OF MARINE HABITAT MEASUREMENTS  
SALT MARSHES  
NEW YORK

County	Town	Marine Wetlands <sup>a</sup>		L. I. Marine Wetlands <sup>b</sup>		Reg. Marine Res. Councils		Tri-Statel NESE Spinnerf	
		#	Acres	#	Acres	#	Acres	#	Acres
	Hudson River								
	Staten Island								
	West Side								

a U' Connor et al., 1972.

b Office of Planning Services, and Department of Environmental Conservation, 1972.

c Smith et al., 1970.

Tri-State Regional Planning Commission, 1973.

e U.S. Department of Interior, , National Estuary Study, (NES).

f. Spinner, et al., 1969.

Table E-15  
SUMMARY OF MARINE HABITAT MEASUREMENTS  
SALT MARSHES  
NEW JERSEY

County	Town	DEP <sup>a</sup> Acres
Bergen		NA
Passaic		NA
Hudson		NA
Essex		NA
Union		NA
Middlesex		4980
Monmouth		1716

<sup>a</sup> New Jersey Department of Environmental Protection, 1974,  
personal communication.

NA Data not compiled by Department of Environmental Protection.

Table E-16  
SUMMARY OF MARINE HABITAT MEASUREMENTS  
WORM-CLAM FLATS  
MAINE

County	Town	Reed <sup>a</sup>		Maine Wetlands <sup>b</sup>	
		#	Acres	#	Acres
Washington	Robbinston	3	162.6		
	Perry	8	645.6		
	Eastport	4	322.4		
	Pembroke	7	651.1		
	Dennysville	1	20.4		
	Edmunds	4	464.8		
	Trescott	9	656.1		
	Lubec	14	2494.9		
	Cutler	3	1750.1		
	Machiasport	15	1317.9		
	E. Machias	2	111.9		
	Rogue Bluffs	6	606.9		
	Jonesboro	3	229.8		
	Jonesport	10	947.9		
	Addison	8	1289.6		
	Beals	2	22.7		
	Harrington	11	1785.9		
	Milbridge	12	931.6		
	Steuben	18	851.7		
	Subtotal, County	140	15154.	193	21707
Hancock	Gouldsboro	11	1184.0		
	Winter Harbor	1	73.7		
	Sorrento	3	63.6		
	Sullivan	3	132.3		
	Hancock	4	694.4		
	Lamoine	5	1401.0		
	Trenton	2	648.0		
	Bar Harbor	2	541.3		
	Brooklin	3	43.3+		
	Swans Island	3	167.8		
	Deer Isle	7	912.5		
	Stonington	4	180.3		
	Brooksville	10	603.9		
	Castine	4	363.7		
	Subtotal, County	129	8941	160	11082

Table E-16

Waldo	Stockton Spring	4	352.8		
	Searsport	6	419.7		
	Belfast	3	206.2		
	Northport	3	66.1		
	Lincolnville	1	50.8		
	Isleboro	7	468.2		
	Subtotal, County	24	1563	55	2308
Knox	North Haven	2	71.3		
	Vinalhaven	3	34.1		
	Camden	2	40.6		
	Rockport	1	22.9		
	Rockland	3	206.0		
	Owls Head	2	89.0		
	S. Thomaston	5	423.7		
	St. George	15	789.6		
	Cushing	7	709.9		
	Friendship	3	279.3		
	Subtotal, County	43	2666.	98	5177
Lincoln	Waldoboro	6	857.3		
	Bremen	4	109.4		
	Bristol	7	223.6		
	S. Bristol	14	354.2		
	Boothbay	9	229.1		
	Boothbay Harbor	8	58.4		
	Newcastle	2	63.5		
	Edgecomb	2	71.2		
	Southport	10	70.9		
	Westport	2	88.9		
	Subtotal, County	61	2176	78	4790
Segadahoc	Woolwich	2	483.3		
	Georgetown	7	656.2		
	Arrowsic	2	170.4		
	Phippsburg	20	646.5		
	W. Bath	5	161.3		
	Subtotal, County	36	2117	28	4025
Cumberland	Harpwell	63	2326.2+		
	Brunswick	8	1839.6		
	Freeport	12	1418.6+		
	Yarmouth	11	477.2+		
	Cumberland	5	465.7		
	Falmouth	3	730.0		
	Portland	1	66.1		
	Cape Elizabeth	3	52.7		
	Scarborough	8	238.7		
	Subtotal, County	114	72724	56	8496

Table E-16

York	Biddeford	5	116.9		
	Kennebunkport	8	660.8		
	Kennebunk	1	10.0		
	Ogunquit	1	40.4		
	Wells	1	53.0		
	York	4	26.5		
	Kittery	5	89.6		
	Eliot	6	171.5		
	Subtotal, County	32	1233	15	1875

a Reed & D'Andrea, 1973.

b Maine Department of Inland Fisheries & Game, 1972, Manual for Marine Wetlands Inventory.

Table E-17

SUMMARY OF MARINE HABITAT MEASUREMENTS  
WORM-CLAM FLATS  
NEW HAMPSHIRE

County	Town	Area	Acres
Rockingham	Hampton and Seabrook	Hampton-Seabrook	3000-4000 <sup>a</sup>
	Rye	Rye Harbor Marsh	1000 <sup>b</sup>
	Newmarket and Greenland area	Great Bay	7860 <sup>c</sup>

a Barrett, late 1960's.

b Barrett, 1974, personal communication.

c New Hampshire State Planning & Development Commission, 1945.

Table E-18  
SUMMARY OF MARINE HABITAT MEASUREMENTS  
WORM-CLAM FLATS  
MASSACHUSETTS

County	Town	DNRA		Watershed	DNR <sup>a</sup>	
		# Flats	Acres		# Flats	Acres
Essex	Salisbury	2	217.8	Merrimack River estuary		
	Newburyport	11	530.1			
	Newbury	24 <sup>c</sup>	114.7			
	(North of Plum Island Turnpike)				15	862.6
	Ipswich	25	574.3	Parker River-Plum Island		
	Rowley	9	47.7			
	Newbury	8	139.1		42	761.1
	Ipswich	4	59.6	Essex Bay		
	Essex	15	340.7			
	Gloucester	4	100.1		23	500.4
	Gloucester	21	508.1	Gloucester-Annisquam River	21	508.1
	Nahant	1	42.5	Lynn-Saugus Harbor		
	Lynn	5	98.3			
	Saugus	8	123.1			
	Subtotal, County	118	2896.1			
Suffolk	Revere	8	176.0		22	439.9
	Boston	10	625.1	Dorchester Bay		
Norfolk	Quincy	3	290.2			
	Milton	2	59.3		15	974.6
	Quincy	9	613.4	Quincy Bay		
	Hull	2	54.0			
	Subtotal, County	16	1016.9			
Suffolk	Boston	2	56.8			
	Subtotal, County	20	857.9		13	724.2

Table E-18  
SUMMARY OF MARINE HABITAT MEASUREMENTS  
WORM-CLAM FLATS  
MASSACHUSETTS

County	Town	DNR <sup>a</sup>		Watershed	DNR <sup>a</sup>	
		# Flats	Acres		# Flats	Acres
Plymouth	Hingham	1	NA <sup>d</sup>	Plymouth Bay		
	Hull	1				
	Scituate	4				
	Marshfield	5				
	Duxbury	4				
	Kingston	1				
	Plymouth	1				
	Wareham	6				
	Marion	4				
	Mattapoissett	1				
	Subtotal, County	24+	5668+		24+	5668+
Barnstable	Wellfleet	8	3000	Wellfleet Harbor	8	3000
	Waquoit	22	550	Waquoit Bay- Eel Pond Estuary	22	550
	Chatham	2+	640+	Pleasant Bay	2+	640+
	Harwich					
	Orleans					
	Subtotal, County	32+	4190+			
Bristol	Westport	19+	589+	Westport River	19+	589+
	Subtotal, County	19+	589+		19+	589+
Total, State		261+	5668+		261+	5668+
(Partial total - only those areas inventoried by Dept. of Natural Resources have available data)						
Total, State by Spinner <sup>b</sup>			28000			

a Massachusetts Department of Natural Resources, 1965-1973

b Spinner, et al., 1969.

c + - Partial Total

d NA - Not Available

Table E-19  
SUMMARY OF MARINE HABITAT MEASUREMENTS  
SHELLFISH  
(SOFT-SHELLED CLAMS, QUAHAUGS, SCALLOPS, CONCHS)  
RHODE ISLAND

County	Area <sup>a</sup>	Approximate <sup>a</sup> Acres
Newport	Quicksand Pond	376 <sup>b</sup>
	Tunipus Pond	49 <sup>b</sup>
	Briggs Marsh	260 <sup>b</sup>
	Sahonnet River	3700
	Spectacle Cove	217
	Potter Cove	102
	Prudence Island, East side	597
	Prudence Island, West side (Pine Hill)	128
	Subtotal, County (Partial)	5429
Newport and Bristol	Mount Hope Bay	8571
Bristol	Kickamuit River	441
	Bristol Harbor	1000
	Barrington Beach	204
	Subtotal, County (Partial)	1645
Bristol and Kent	Pawtuxet, above Longmeadows	5618
	East of Warwick	9451
Kent	Longmeadows	339
	Greenwich Bay	5723
	Greenwich Bay, North Shore	528
	Mountain View	3330
	Subtotal, County (Partial)	9920

Table E-19  
SUMMARY OF MARINE HABITAT MEASUREMENTS  
SHELLFISH  
(SOFT-SHELLED CLAMS, QUAHAUGS, SCALLOPS, CONCHS)  
RHODE ISLAND

County	Area <sup>a</sup>	Approximate <sup>a</sup> Acres
Washington and Newport	Lower West Passage, Narragansett Bay (Wickfor Harbor & Dutch Island Harbor)	3444
Washington	Narrows River	308 <sup>b</sup>
	Pettaquamscutt River	236 <sup>b</sup>
	Pt. Judith Pond	2663
	Potters Pond	300 <sup>b</sup>
	Cards Ponds	43 <sup>b</sup>
	Green Hill Pond	430 <sup>b</sup>
	Ninigret Pond (Charlestown Pd.)	1550 <sup>b</sup>
	Ouonochontaug Pond	750 <sup>b</sup>
	Winnapaug Pond	537 <sup>b</sup>
	Maschaug Pond	40 <sup>b</sup>
	Subtotal, County (Partial)	6857
Total, State		50933

<sup>a</sup> Sisson & Russell, 1974.

<sup>b</sup> Wright et al., 1949.

Table E-20

SUMMARY OF MARINE HABITAT MEASUREMENTS  
SHELLFISH  
CONNECTICUT

County	Town	Conn. Dept. Ag. <sup>a</sup> Acres	Tri-State <sup>b</sup> Acres	Matthiesson <sup>c</sup> Acres
New London	Groton	76.0		
	New London	16.0		
	Niantic	10.0		
	Subtotal, County	102.0		
New Haven	Madison-Guilford	50.0		
	Branford	145.0		
	Easr Haven	475.2		
	New Haven	2875.4		
	Quinnipiac River			
	East side	44.7		
	West side	34.6		
	Mill River	5.6		
	West River	3.0		
	West Haven	4867.5		
Fairfield	Milford	4793.2		
	Subtotal, County	13294.2		
	Stratford	2425.0		
	Bridgeport	2576.4		
	Fairfield	35.3		
	Westport	4927.9		
	Norwalk	1232.8		
	Darien	368.2		
Fairfield	Stamford	246.8		
	Greenwich	1439.2		
	Subtotal, County	13251.6		
Total, State		71414	64000	60000

a Connecticut Dept. of Agriculture, Aquaculture Division, 1973.

b Tri-State Regional Planning Commission, 1973.

c Matthiesson, 1970(?).

Table E-21  
SUMMARY OF MARINE HABITAT MEASUREMENTS  
SHELLFISH  
NEW YORK

County	Town
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Statistical data not compiled by Department of Environmental  
Conservation.

Table E-22  
SUMMARY OF MARINE HABITAT MEASUREMENTS  
SHELLFISH  
NEW JERSEY

County	Town	Area	DEP <sup>a</sup> Acres
Monmouth & Middlesex		Raritan, Low, and Sandy Hook Bay complex	33000

a New Jersey Dept. of Environmental Protection, Water Resources  
William Eisele, Personal Communication, 1974.

Table E-23  
SUMMARY OF MARINE HABITAT MEASUREMENTS  
OYSTER-MUSSEL REEFS  
MAINE

County	Town	Reed <sup>a</sup>		Species	Maine Resources <sup>b</sup>	
		#	Acres		#	Species
Washington	Steuben	1	1.7	Mussel		
Lincoln	Southport	1	10.1	Mussel	2	Oyster, Mussel
	Boothbay Harbor				1	Oyster
	Newcastle				3	Oyster
						(1954 Survey)
Sagadahoc	Phippsburg	2	NC <sup>c</sup>	Mussel	1	Mussel
Cumberland	Island				1	Mussel
	Bailey Island				1	Mussel
	S. Harpswell				2	Mussel
	Freeport				1	Mussel
	Yarmouth				1	Mussel
	Chebeague Island				1	Mussel
	Scarborough				1	Mussel
York	Biddeford				3	Mussel
	Ogunquit				2	Mussel
	Cape Neddick				2	Mussel
	York				2	Mussel
	Kittery				1	Mussel

a Reed & D'Andrea, draft report, 1973.

b Maine Department of Marine Resources, 1966.

c NC - Not Computed.

Table E-24  
SUMMARY OF MARINE HABITAT MEASUREMENTS  
OYSTER-MUSSEL REEFS  
NEW HAMPSHIRE

County	Town	Area	Acres
Rockingham	Newmarket and Greenland area	Great Bay	NA
		Oysters distributed throughout bay. Extensive oyster sport fishery exists.	

Table E-25  
SUMMARY OF MARINE HABITAT MEASUREMENTS  
OYSTER BEDS  
MASSACHUSETTS

County	Town	Mass. DNR <sup>a</sup>		
		#	Acres	
Essex	Newburyport	NA	NA	Attempted plantings in Parker River; Success doubtful
	Subtotal, County	NA	NA	
Plymouth	Wareham	6	NA	
	Marion	2	NA	
	Mattapoisett	1	NA	
	Subtotal, County	9	NA	
Barnstable	Wellfleet	9	1292	Natural population
	Waqquoit	1	NA	Seapit River planting partly successful
	Chatham	4	NA	Pleasant Bay planting partly successful
	Subtotal, County	14	1292+	
Bristol	Westport	1	NA	Natural population, 2-4 miles Above mouth of Westport River
	Subtotal, County	1	NA	
	Total, State	48+	1292+	

<sup>a</sup> Massachusetts Department Natural Resources, 1965-1973.

Table E-26

SUMMARY OF MARINE HABITAT MEASUREMENTS  
OYSTER & MUSSEL BEDS  
RHODE ISLAND

County	Town	Area <sup>a</sup>	Acres	Species
Newport	Little Compton	Quicksand Pond	376 <sup>b</sup>	Oysters
		Briggs Marsh	260 <sup>b</sup>	Oysters
		Sakonnet Point	NA	Mussels
	Middletown	Newport Harbor (Closed)	NA	
	Jamestown	Jamestown Island,	NA	Mussels
		Southern end	4 small areas	
		Jamestown Harbor	NA	
Kent	Warwick	Longmeadows	339 <sup>a</sup>	Mussels
	Greenwich	Hunt River	NA	Oyster, Transplanted
Washington	N. Kingstown	Wickford Harbor	NA	Oysters
		Wickford, Southern coast	NA	
		Hamilton	NA	Oysters Mussels
	Narragansett	Bonnet Point	NA	
		Narrows River	NA	Mussels
		Pt. Judith Pond,		
	S. Kingstown	Northern end	NA	Oysters
		Potters Pond,	NA	Oysters
		Northern end		
		Trustom Pond	NA	Oysters
	Charlestown	Green Hill Pond	430 <sup>b</sup>	
		Charlestown Pond,	NA	Oysters
		Northern finger		
	Westerly	Ninigret Pond	NA	Oysters
		Winnapaug Pond,		
		Western end	NA	Oysters
				Transplanted from Pawcatuck River
		Maschaug Ponds	NA	Oysters
		Little Narragansett Bay,	NA	Oysters
		Pawcatuck River,	NA	Oysters
		Lower end to dam		

<sup>a</sup> Sisson & Russell, 1974, personal communication.

<sup>b</sup> Wright et al., 1974.

Table E-27  
SUMMARY OF MARINE HABITAT MEASUREMENTS  
SALT PONDS  
MASSACHUSETTS

County	Town	Smayda <sup>a</sup>		Metcalf <sup>b</sup>		NSS <sup>c</sup>	
		Pond	Acres	Pond	Acres	Pond	Acres
Barnstable	Falmouth	Great Pond	320				
	N A	Oyster Pond	62				
Dukes	Martha's Vineyard			4	Large		
Nantucket	Nantucket					N A	N A
						Southern Shore	
						scalloped by ponds	

a Smayda, 1973.

b Metcalf & Eddy, 1971.

c U.S. Army Engineer Division, 1971, National Shoreline Study (NSS).

Table E-28  
SUMMARY OF MARINE HABITAT MEASUREMENTS  
SALT PONDS  
RHODE ISLAND

County	Town	Pond	Water Resources <sup>a</sup>		Wright <sup>b</sup>
			#	Acres	Acres
Newport	Little Compton	Quicksand		318	376
		Tunipus		51	49
		Briggs Marsh		213	260
		Long Pond		40	
		Round Pond		34	
	Tiverton	Nannaquaket		205	
	Middletown	Easton		132	
		Gardiner		90	
	Newport	Green End		125	
		Nelson		29	
	Jamestown	Fox Hill		31	
	subtotal, county		11	1268	
Washington	Narragansett	Point Judith		1064	2663
		Wesguage		54	
	South Kingston	Potter		391	300
		Cards		38	43
		Truston		157	
		Green Hill		429	430
	Charlestown	Ninigret		1455	1550
		Foster Cove		59	
		Quonochontaug		763	750
	Westerly	Winnapaug		489	537
		(Brightmans)			
		Maschaug		37	40
		Little Maschaug		13	
		Fort Neck		85	
	New Shoreham (Block Island)	Great Salt Pond		535	
		Trims Salt Pond		8	
	subtotal, county		15	5577	
total, state			26	6845	

<sup>a</sup>Rhode Island Water Resources Board, 1974  
<sup>b</sup>Wright et al., 1949

Table E-29  
SUMMARY OF MARINE HABITAT MEASUREMENTS  
SALT PONDS  
CONNECTICUT

County	Town
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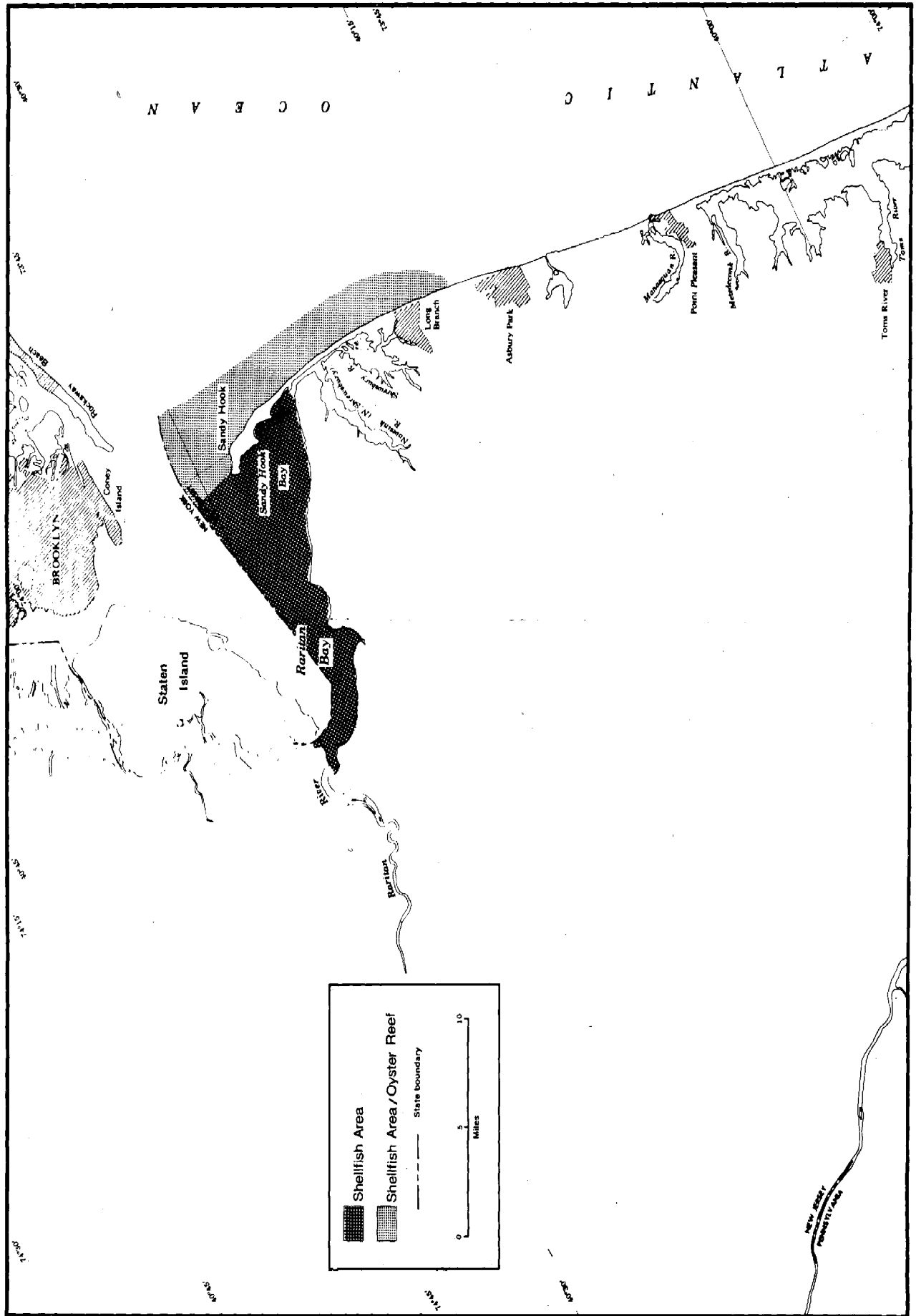
Table E-30  
SUMMARY OF MARINE HABITAT MEASUREMENTS  
SALT PONDS  
NEW YORK

County	Town	NES <sup>a</sup>
Nassau and Suffolk		6000 acres Great South Bay

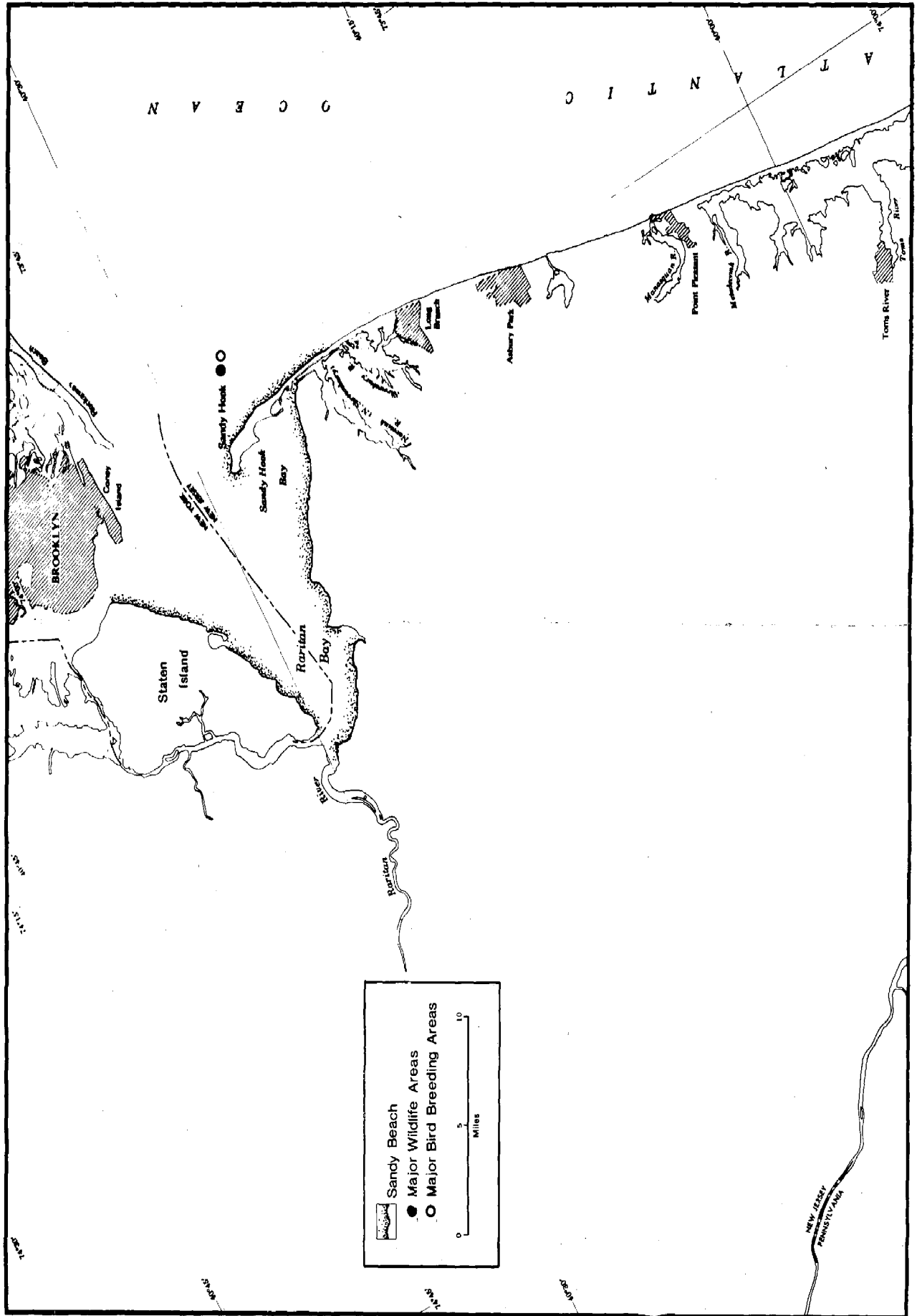
a U. S. Department of Interior, National Estuary Study (NES), 1972

Table E-31  
SUMMARY OF MARINE HABITAT MEASUREMENTS  
SALT PONDS  
NEW JERSEY

County	Town
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# Marine Habitats



# Marine Habitats

### E.3. REFERENCES

- Barrett, Burdett. (personal communication, 1974) New Hampshire Department of Fish and Game.
- Bateo, Stanley J. (personal communication, 1974) Connecticut Department of Environmental Protection, Parks and Recreation.
- Brown, Robert P., William H. Moser, Edward H. Shenton. 1972. National Beach Inventory, Technical Report. Vol. II. Plessey Environmental Systems report prepared for U.S. Environmental Protection Agency, Office of Water Programs.
- Brown, Robert P., William H. Moser, Edward H. Shenton. 1972. National Beach Inventory, Computer print-out. Plessey Environmental Systems report to U.S. Environmental Protection Agency, Office of Water Programs.
- Caldwell, Bill. Maine's 3,344 islands...who owns them legally? Portland, Maine: Maine Sunday Telegram, March 31, 1974.
- Campbell, Robert. 1966. State of Maine Shellfish Resource Atlas. U.S. Dept. of Health, Education & Welfare, Public Health Service, Shellfish Sanitation Branch, Northeast Resource Center, Narragansett, R. I. continually updated by Maine Dept. of Marine Resources, Augusta, Maine.
- Chesmore, Arthur P., David Brown, and Robert Anderson. 1972. A study of the marine resources of Lynn-Saugus Harbor. Mass. Dept. of Natural Resources, Division of Marine Fisheries, Monograph Series, #11.
- Chesmore, Arthur P., David Brown, and Robert Anderson. 1973. A study of the marine resources of Essex Bay. Mass. Dept. of Natural Resources, Division of Marine Fisheries, Monograph Series, #13.
- Chesmore, Arthur P., Salvatore A. Lestaverde, and F. Paul Richards. 1971. A study of the marine resources of Dorchester Bay. Mass. Dept. of Natural Resources, Division of Marine Fisheries, Monograph Series, #10.
- Connecticut Dept. of Agriculture, Aquaculture Division. 1973. Shellfish Laws, Index to Oyster Grounds. General Information.
- Connecticut Dept. of Agriculture, Aquaculture Division. 1974. Maps of leased and franchised shellfish beds.
- Curley, John R., Robert Lawton, J. Hickey and John Fiske. 1968. A study of the marine resources of the Waquoit Bay - Eel Pond estuary. Mass. Dept. of Natural Resources, Division of Marine Fisheries, Monograph Series, #9.

- Curley, John R., Robert P. Lawton, David K. Whittaker and John M. Hickey. 1972. A study of the marine resources of Wellfleet Harbor. Mass. Dept. of Natural Resources, Division of Marine Fisheries, Monograph Series, #12.
- Eisele, William (personal communication, 1974) New Jersey Dept. of Environmental Protection, Division of Water Resources.
- Fiske, John D., John R. Curley and Robert Lawton. 1968. A study of the marine resources of the Westport River. Massachusetts Dept. of Natural Resources, Division of Marine Fisheries, Monograph Series, #7.
- Fiske, John D., Clinton E. Watson and Philip G. Coates. 1967. A Study of the Marine Resources of Pleasant Bay. Massachusetts Dept. of Natural Resources, Division of Marine Fisheries, Monograph Series, #5.
- Green, Ralph. 1972. Wetlands on Long Island. Hauppauge, N. Y., Regional Marine Resources Council, Nassau-Suffolk Regional Planning Board, 33P & app.
- Hill, David and A.E. Shearin. 1970. Tidal Marshes of Connecticut and Rhode Island, Bulletin 709. New Haven, Connecticut Agricultural Experiment Station, 34p.
- Jerome, William C., Jr., Arthur P. Chesmore, and Charles O. Anderson. 1966. A study of the marine resources of Quincy Bay. Massachusetts Dept. of Natural Resources, Division of Marine Fisheries, Monograph Series, #2.
- Jerome, William C., Jr., Arthur P. Chesmore and Charles O. Anderson, Jr. 1968. A study of the marine resources of the Parker River - Plum Island sound estuary. Massachusetts Dept. of Natural Resources, Division of Marine Fisheries, Monograph Series, #6.
- Jerome, William C., Jr., Arthur P. Chesmore and Charles O. Anderson, Jr. 1969. A study of the marine resources of the Annisquam River - Gloucester Harbor coastal system. Mass. Dept. of Natural Resources, Division of Marine Resources, Monograph Series, #8.
- Jerome, William C., Jr., Arthur P. Chesmore, Charles O. Anderson and Frank Grice. 1965. A study of the marine resources of the Merrimack River estuary. Massachusetts Dept. of Natural Resources, Division of Marine Fisheries, Monograph Series, #1.
- MacConnell, William P. 1972. Unpublished land use inventory, obtained through New England River Basins Commission, Boston.
- Maine Department of Inland Fisheries and Game. 1972. Manual for Maine Wetlands Inventory, revised by Cheryl A. McCall. Augusta, Maine, Dept. of Inland Fisheries and Game, 37p.

- Maine State Planning Office, Coastal Planning Unit. 1974. Unpublished tables, ongoing project. Augusta, Maine.
- Maine State Planning Office, Coastal Planning Unit. 1972. The Penobscot Bay Resource Plan. Augusta, Maine, State Planning Office, 38p.
- Mass. Dept. of Natural Resources, Division of Conservation Services, Bureau of Planning. 1973. Massachusetts Outdoor Recreation Plan. Boston.
- Matthiesson, George C. A Review of Oyster Culture and the Oyster Industry in North America. Woods Hole, Mass., Woods Hole Oceanographic Institution, 52p.
- Martin, Hotchkiss, Uhler, Brown. 1953. Classification of wetlands of the United States. U. S. Fish & Wildlife Service Special Science Report. Wildlife, 20, 14p.
- Metcalf and Eddy. 1972. Summary of the Comprehensive Plan for Dukes County, Massachusetts. Oak Bluffs, Mass., Dukes County Planning and Economic Development Commission.
- Murphy, James (personal communication, 1974) Connecticut Department of Environmental Protection.
- National Ocean Survey, National Oceanic and Atmospheric Administration. U. S. Dept. of Commerce. 1971. The coastline of the United States. Washington, D. C., U. S. Government & Printing Office.
- New Jersey Dept. of Environmental Protection, Division of Water Resources, Bureau of Water Pollution Control, Shellfish Control Section. 1974. maps of condemned shellfish areas.
- New York State Dept. of Environmental Conservation, Shellfisheries Management Unit. 1974. Maps of shellfish areas and areas certified for shellfishing. Stony Brook, State University of New York.
- New York State Planning Office of Planning Services. 1972. Long Island Marine Wetlands. N.Y., Office of Planning Services, 60p.
- O'Connor, Joel S. and Orville W. Terry. 1972. The Marine Wetlands of Nassau - Suffolk Counties. Stony Brook, N.Y., State University of New York, Nassau - Suffolk Regional Planning Board and Marine Science Research Center, 99p.
- Odum, H.T., B.J. Copeland, Elizabeth A. McMahan, ed. 1969. Coastal Ecological Systems of the United States, Volume 1, a report to Federal Water Pollution Control Administration, contract RFP 68-128. Moorehead City, University of North Carolina, Institute of Marine Science.

- Redfield, Sarah. 1972. A Working Paper, Maine Saltmarsh. unpublished paper to the Maine Audubon Society.
- Reed and D'Andrea. 1973. Unpublished draft, Conservation Priorities Plan, Coastal Overview. South Gardiner, Maine, Reed and D'Andrea.
- Rhode Island Dept. of Agriculture and Conservation, Division of Fish & Game. 1965. Rhode Island Salt Water Marsh Inventory. available from R. I. Dept. of Natural Resources, Fish & Wildlife Division.
- Rodiek, Jon. 1973. A Natural Resources Inventory Atlas for Plymouth County. Amherst, Mass., University of Massachusetts, Cooperative Extension Service, 133p.
- Rorholm, Niels, H.C. Lampe, Nelson Marshall, J.F. Farrell. 1967. Economic Impact of Marine-Oriented Activities - A Study of the Southern New England Marine Region, Bulletin 396. Kingston, R.I., University of R.I., Dept. of Food and Resource Economics, Agricultural Experiment Station.
- Sisson, Richard and Howard Russell, Jr. (personal communication, 1974) Rhode Island Marine Fisheries Base, Wickford, Rhode Island.
- Smayda, T.J. 1973. Phytoplankton. In Coastal and Offshore Environmental Inventory, Cape Hatteras to Nantucket Shoals, Chapter 3. Kingston, R.I. University of Rhode Island.
- Smith, R.A., L. Ortolano, R.M. Davis, R.O. Brush, of The Travelers Research Corporation, Hartford, Connecticut. 1970. Fourteen Selected Marine Resource Problems of Long Island, N.Y. - Descriptive Evaluations. Hauppauge, N.Y., Regional Marine Resources Council, Nassau-Suffolk Regional Planning Board, 127p.
- Spinner, George F. 1969. Serial Atlas of the Marine Environment, Folio 18, The Wildlife Wetlands and Shellfish Areas of the Atlantic Coastal Zone. N.Y., American Geographical Society.
- Spinner, George F. 1969. A Plan for the Marine Resources of the Atlantic Coastal Zone. N.Y., American Geographical Society.
- Technical Committee, State of Rhode Island. 1970. State of Rhode Island Report of the Governor's Committee on the Coastal Zone. Providence, R.I., Statewide Planning Program, 119p. and app.
- Tri-State Regional Planning Commission. 1973. An Interior Management Guide for the Tri-State Coastal Zone, unpublished internal report. N.Y. Tri-State Regional Planning Commission, 82p.
- Tucker, Charles (personal communication, 1974) Southeastern New Hampshire Planning Agency.

U.S. Army Engineer Division, North Atlantic Corps of Engineers. 1971. National Shoreline Study, Regional Inventory Report, North Atlantic Region, Vol I & II.

U.S. Dept. of Agriculture, Soil Conservation Service, in cooperation with N.H. Agricultural Experiment Station. 1959. Soil Survey of Rockingham County, New Hampshire, Series 1954, #5. Washington D.C., U.S. Government Printing Office.

U.S. Dept. of Commerce, National Oceanic & Atmospheric Administration, National Ocean Survey. Coastal & Geodetic Survey Charts, series 1200, 300, 200. Small Craft Nautical Charts.

U.S. Dept. of Interior, Federal Water Pollution Control Administration, New England Basins Office. 1970. State of Connecticut Shellfish Atlas.

U.S. Dept. of the Interior, Fish & Wildlife Service. 1970. National Estuary Study, App. B, Management Studies.

Wright, T.J., V.I. Cheadle, E.A. Palmatier. 1949. A survey of Rhode Island's salt and brackish water ponds and marshes, Pittman Robertson Pamphlet #2. R. I. Dept. Agriculture and Conservation, Division of Fish and Game.

## **Appendix**

# **F Report Specifications**

Page

Appendix F      Contract Work Statement

F.1      Bureau of Land Management Contract  
08550-073-8 and Report Specifications

F-2

APPENDIX F BUREAU OF LAND MANAGEMENT CONTRACT 08550-073-8 AND  
REPORT SPECIFICATIONS.

Article I. Scope of Work.

Sec. 1.1 Objectives. This socio-economic and environmental inventory of the Outer Continental Shelf and adjacent waters of the North Atlantic (Sandy Hook, New Jersey, to the Bay of Fundy) is conducted with the following objectives:

- A. To develop a comprehensive inventory of marine environmental data for the coastal zone and adjacent waters of the outer continental shelf.
- B. To conduct a study of the socio-economic factors operating in the region.
- C. To combine these previous steps into a comprehensive compilation for use in preparing impact assessments of the developments of offshore energy resources.
- D. To define the gaps and deficiencies that exist in the present information baseline as preliminary to conducting new research and field surveys.

Sec. 1.2 Procedures. The study will consist of a detailed summary of all currently available information. Graphics (maps, tables, graphs, photos, etc.) will be used extensively to summarize data and supplement the written text. The data will be presented in such a manner that it may be used (1) as the basis for assessing potential environmental impacts that might result from OCS leasing activities, (2) for planning the development of OCS energy resources, and (3) planning feasibility of coastal facilities development. In summary, the report will include:

- A. A description of the existing physical, biological and socio-economic characteristics and resources of the study area.
- B. A description of the economic utilization of the area's resources and industrial activity effecting the study area,
- C. A discussion of present and potential conflicts and interactions between environmental considerations and resources uses,
- D. A discussion of environmental information still needed to fully assess the impact of leasing activities and development of energy and other resources in the study area, and
- E. A comprehensive bibliography,

F. A study of available socio-economic data presented on the enclosed outline.

A detailed outline of the proposed report is presented in Article II below.

Article II. Proposed Outline.

Sec. 2.1 Coastal Zone Environmental Topics to be Inventoried.

Physical Environment

A. Estuaries

1. Location, area, geographical complexity
2. Fresh water input
3. Salinity and temperature profiles
  - (a) vertical
  - (b) along estuary axis
4. Characterization of circulation (i.e., Pritchard classifications) Types A, B, C, D

B. Tides

1. Heights (diurnal/semidiurnal character)
2. Current patterns (longshore currents) and velocities

C. Major Embayments (for example, L. I. Sound, Casco Bay, etc.)

1. Location, area
2. Characterization of currents

D. Wave Regime

1. Wave statistics (period, height, yearly histograms)
2. Possible effects of wave transport

E. Shelf Water Hydrography

1. Temperature, salinity, sigma-t
2. Currents

F. Currents Along Slope (Density Currents, etc.)

Chemical Oceanography

A. Physical Parameters Interface

1. Temperature

2. Salinity

3. Density

B. Biologically Active Natural Components

1. Oxygen

2. Phosphate

3. Nitrate-Nitrite-Ammonia

4. Silicate

5. Dissolved Organic Carbon

C. Suspended Inorganic Particulate Matter

D. Heavy Metals (e.g. Fe, Cu, Zn, Cd, Hg, Pb, etc.)

E. Organic Pollutants (e.g. hydrocarbons, DDT, PCB, etc.)

Material above presented for open Continental Shelf waters, major sounds and embayments.

System Ecology (Terrestrial and Marine)

General Description

Phytoplankton

A. Regional Variations

1. Coastal lagoons, salt ponds

2. Bays

3. Sounds

4. Continental Shelf

The following specific regions will be included: Casco Bay, Buzzards Bay, Penobscot Bay, Passamaquoddy Bay, Bay of Fundy, Massachusetts Bay, Narragansett Bay, Sandy Hook, Block Island Sound, Long Island Sound.

B. Seasonal variation in phytoplankton abundance and species composition

C. The seasonal and regional variations in:

1. Annual cycles

2. Phytoplankton productivity

3. Influence of pollutants

4. Environmental background for cycles

5. Red tides

- D. Phytoplankton models where available
- E. Perspectives and future problem areas both regional and for phytoplankton dynamics

## Zooplankton

Literature review and perspectives on the following:

- A. Distribution
  - 1. Ranges of the major holoplankton species
  - 2. Origin and dispersal of seasonal populations
  - 3. Dominance orders of the major copepod species
- B. Abundance
  - 1. Standing crop estimates of the total zooplankton
  - 2. Regional variability, species diversity and stability of the standing crop (insofar as these calculations can be made and compared with the data that are available)
- C. Relationships
  - 1. Temperature
  - 2. Salinity
  - 3. Depth
  - 4. Food

The major method of synthesizing the voluminous baseline information that is available will be in the form of easy-to-use comparative tables. Textual descriptions will be adequate so that in the event of a suspected environmental abnormality in the future, the document will quickly direct the reader's attention to the pertinent quantitative information.

## Benthos

- A. Autecology (Physiological Ecology and Behavior)
  - 1. Benthic invertebrate response to:
    - a. temperature
    - b. salinity
    - c. light
    - d. turbidity
    - e. dissolved oxygen
    - f. toxic substances

Treated by taxonomic group with emphasis on commercial species and indicator organisms. Response includes growth rate, mortality, disease resistance and substrate choice.

B. Synecology (Population and Community Ecology)

1. Major communities

- a. intertidal
- b. subtidal
- c. macro-benthos
- d. meio-benthos
- e. micro-benthos

Zoogeography, standing crop, productivity, trophic webs and diversity will be discussed.

Fisheries Resources

A. Major Invertebrate and Vertebrate Recreational Resources

- 1. Distribution and depths
- 2. Breeding biology and life history
- 3. Utilization of estuarine and coastal areas
- 4. Migrations
- 5. Population abundance and ranges
- 6. Major fishing areas
- 7. Catch statistics and value

B. Major Invertebrate and Vertebrate Commercial Resources

1 through 7 as above

C. The following species will be included as a minimum:

bait worms	alewife & blueback herring	blue marlin
northern lobster	American shad	swordfish
northern shrimp	Atlantic menhaden	butterfish
red crab	Atlantic herring	summer flounder
blue crab	American eel	yellowtail
surf clam	various bait fishes	flounder
soft clam	pollack	winter flounder
eastern oyster	silver hake	industrial
hard clam	white perch	fishes
striped bass	scup	
blue fish	cod	
spiny dogfish	Atlantic mackerel	
Atlantic salmon	white marlin	

Graphs or charts of geographical distribution of important species will be included.

#### Marine Mammals

##### A. Pinniped species

1. Current status of species
2. Trends in population size with time
3. Distribution
4. Movement
5. Food habits
6. Economic or aesthetic values

##### B. Cetacean species

1 through 6 as above

#### Birds

- A. Distribution
- B. Population Densities
- C. Breeding Success
- D. Long-Term Cycles
- E. Habitat Preferences
- F. Occasional Occurrence
- G. Migration Routes
- H. Peculiarity of Local Incidence

#### Major Invertebrate and Vertebrate Animals

A list of threatened and endangered species within the coastal zone.

#### Geology (Terrestrial and Marine)

##### A. Introduction

1. Regional geology
2. Rivers and other sources of sediment
3. General oceanography
4. Previous workers

##### B. Bathymetry and Morphology

1. General bathymetry (shelf and slope)
2. Morphologic features on shelf
  - a. channels and canyons

- b. ridges - origin and age
  - c. terraces - age
- 3. Morphologic features on slope
  - a. declivity and variations in it
  - b. canyons
  - c. slumps
- C. Structure (including seismic profiles, magnetics, gravity, etc.)
  - 1. Shallow structure - Quaternary
  - 2. Deeper structure
- D. Sediments in coastal zone and shelf
  - 1. Distribution of sediment samples
  - 2. Sedimentological parameters (including texture, heavy minerals, engineering parameters, related to human use)
  - 3. Source, origin and age of sediments
- E. Economic Potential
  - 1. Sand, gravel and mud
  - 2. Heavy minerals
  - 3. Hydrocarbons
  - 4. Locations for installations and deep ports
  - 5. Waste disposal and dumping
- F. Recapitulation and Future Studies
  - 1. Modern sedimentary processes
    - a. Deposition versus non-deposition
      - (1) sources of modern sediments
      - (2) role of currents, internal waves, storms, etc.
      - (3) role of canyons in offshore transport
    - b. Man's influence
  - 2. Quaternary stratigraphy
    - a. Need for quaternary stratigraphic section
    - b. Methods of obtaining it
  - 3. Deeper structure
    - a. Need
    - b. Profiling and Drilling

## G. Bibliography

### Coastal Vegetation

- A. As part of the introduction to this study of Coastal Vegetation the following points will be discussed as they pertain to vegetation patterns.
  1. General configuration of the coast; bays, estuaries, harbors, etc.
  2. Nature of the shoreline and adjacent inland areas
  3. River valleys and other natural routes to the interior
  4. Division of the study area into geographic sub-regions
- B. It is the aim of this proposal to report the extent of information available on coastal vegetation from Sandy Hook to the Bay of Fundy and to supplement that available information with on-site studies. Coastal habitats, including tidal marshes, algal zones, eel-grass beds, fore dunes of sandy beaches, rocky shorelines, and shores of lagoons, bays and estuaries will be covered. The report will determine the following:
  1. The extent and location of sandy beaches having fore dunes
  2. The extent and location of rocky shores (with algal zones)
  3. The acreage and location of tidal marshes, all of which are subject to normal tidal influence
  4. The present extent of residential and recreational real estate development that impinges on the coastal zone that is directly influenced by tidal waters
  5. The present extent and location of industrial development that impinges on the coastal zone that is directly influenced by tidal waters
- C. It is expected that this study will involve the visitation of preselected sites and evaluate the adequacy and relevance of published accounts to the current scene and to plug gaps where they exist.
- D. The information gained in this study should support a vegetation description that would specify those plants that are useful indicators of the range of tidal influence on the shore zone (i.e., those portions regularly flooded by tides, and those portions less frequently flooded by extreme tides).

1. Macro algae
2. Low tidal marsh
3. High tidal marsh
4. Supratidal areas, e.g., beach grass (northward) and sea oats (southward)
5. Evidence of tidal flow over fore dunes during storm surges, particularly during the usual severe winter storms

#### Unique and Endangered Environments

Areas particularly sensitive to man's activities. Although most coastal and marine environments are, to some extent, endangered by pollution, dredging, construction, etc., some are especially important. Peculiar conditions of currents, topography, temperature, biological activity, etc., can get together to form unique environments such as biologically productive zones of upwelling, bird rookeries and others. Detailed descriptions of these locations will be given including:

- a. Name and location
- b. Topography - Bathymetry
- c. Geology
- d. Ecology and biology
- e. Value to man/ecosystem
- f. Nature of vulnerability

#### Meteorology and Climatology

Spatial and temporal characteristics of the following, including long-term averages, frequencies, and extreme values, to be presented in tabular, graphic, and mapped format where appropriate.

- A. The General Atmospheric Circulation
  1. Surface patterns
  2. Upper air patterns
- B. The Secondary Circulation
  1. Cyclone frequencies and tracks
    - a. Frequency of cyclogenesis
  2. Anticyclone frequencies and tracks
    - a. Frequency of anticyclogenesis
  3. Air mass characteristics
  4. Tropical disturbances and hurricanes

C. The Tertiary Circulation (along coast)

1. Land/sea breeze circulation

D. Selected Simple Climatic Elements and Phenomena

1. Wind direction
2. Wind speed
3. Air temperature
4. Relative humidity, dew point temperature, and air moisture content
5. Precipitation: type, amount
6. Thunderstorms and electrical activity
7. Waterspouts
8. Cloudiness: sky cover, cloud height (ceiling)
9. Visibility and fog
10. Looming, mirages
11. Solar radiation
12. Air pollution: sources, dispersion, concentration, etc.

E. Selected Compound Climatic Elements

1. Wind chill values
2. Icing conditions

F. Ocean-Atmosphere Interactions

1. Energy transformation over the water (heat sources and sinks)
  - a. Net radiation
  - b. Evaporation
  - c. Sea surface temperatures
2. Wave height, period and direction
  - a. Storm surges
3. Sea ice and iceberg drift

G. Special Problems

1. Identification of singularities in climatic series
2. Climatic fluctuations and variations
3. Climatic regionalization of the area bounded by Cape Hatteras, Cape Cod, the Atlantic Coast, and the edge of the continental shelf.

## Article II. Proposed Outline.

### Sec.2.1 Coastal Zone Environmental Topics to be Inventoried

#### I. The Environment

##### A. Regional Overview

1. Geology of North Atlantic Region - both terrestrial and marine
2. Meteorology and Climatology
  - a. Generalized pictures of major land/water air circulation pattern
  - b. Identification of airsheds subject to inversion conditions
  - c. Identification of airsheds overstressed by air pollution according to federal air pollution standards
  - d. Precipitation and storm records of major ports
3. Hydrology
  - a. Identification of major surface water systems and drainage patterns.
  - b. Identification of major ground water aquifers and regional flow systems.
  - c. Definition of problem areas
    - (1) Demands exceed local water supply
    - (2) Pollution
4. Biology
  - a. Introduction: Discussion of habitat approach, strengths and limitations. Some treatment of limits of study area and how derived. Need for some topical analysis of man induced features which define habitat approach - recreational and commercial marine resources; unique and endangered environments; threatened and endangered species; other ...discussed in succeeding sections.

#### II. Regional Environmental Systems

##### A. Marine Environments

###### Offshore

##### 1. Geology

###### a. Banks

- (1) Structure (fault, fold, erosional, depositional)
- (2) Sediments (mud, sand, gravel, shell, rock; engineering properties)
  - i. Role of canyons in deposition-erosion process
  - ii. Sources

- iii. Contamination (heavy metals, oil, etc.)
  - b. Shelf (same as for Banks, except (2)i)
  - c. Basins (same as for Shelf)
- 2. Physical Oceanography
  - a. Wave Regime
    - (1) Wave statistics (period, height, yearly histograms)
    - (2) Possible effects of wave transport
  - b. Shelf Water Hydrography
    - (1) Temperature, salinity, sigma-t
    - (2) Currents
  - c. Currents Along Slope (Density currents, etc.)
- 3. Chemical Oceanography
  - a. Biologically active natural components
    - (1) Oxygen
    - (2) Phosphate
    - (3) Nitrate-Nitrite-Ammonia
    - (4) Silicate
    - (5) Dissolved Organic Carbon
  - b. Suspended inorganic particulate matter
  - c. Heavy metals (e.g., Fe, Cu, Zn, Cd, Hg, Pb, etc.)
  - d. Organic pollutants (e.g., hydrocarbons, DDT, PCB, etc.)
  - e. Comparison of ambient levels with water quality standards...identification of stressed areas
- 4. Meteorology and Climatology
 

Spatial and temporal characteristics of the following, including long-term averages, frequencies; and extreme values, to be presented in tabular, graphic, and mapped format where appropriate

  - a. General atmospheric circulation
    - (1) Surface patterns
  - b. Secondary circulation
    - (1) Cyclone frequencies and tracks
      - i. Frequency of cyclogenesis
    - (2) Anticyclone frequencies and tracks
      - i. Frequency of anticyclogenesis
    - (3) Air mass characteristics
    - (4) Tropical disturbances and hurricanes
  - c. Tertiary Circulation (along coast)
    - (1) Land/sea breeze circulation
  - d. Selected simple climatic elements and phenomena
    - (1) Wind direction
    - (2) Wind speed
    - (3) Air temperature
    - (4) Relative humidity, dew point temperature, and air moisture content
    - (5) Precipitation: type, amount
    - (6) Thunderstorms and electrical activity

- (7) Waterspouts
- (8) Cloudiness: sky cover, cloud height (ceiling)
- (9) Visibility and fog
- e. Selected compound climatic elements
  - (1) Wind chill values
  - (2) Icing conditions
- f. Ocean-atmospheric interactions
  - (1) Energy transformation over the water (heat sources and sinks)
    - i. Evaporation
    - ii. Sea surface temperatures
  - (2) Wave height, period and direction
    - i. Storm surges
  - (3) Sea ice and iceberg drift
- g. Air pollution: dispersion, concentration factors
- 5. Biological habitats/ecology
  - a. Plankton-based pelagic
    - (1) Habitat definition
    - (2) Habitat dynamics
      - Environmental characteristics
      - Microenvironments
      - Nutrient cycles
      - Seasonal cycles
      - Food webs
      - Relative productivity
      - Natural stress
    - (3) Effect of man-induced stress
    - (4) Biological components
      - Zonation (distribution)
      - Annotated checklist of species common to the habitat
    - (5) Habitat distribution
    - (6) Bibliography
  - b. Offshore bottom
    - (1) through (6) as above

#### Major Sounds and Embayments

- 1. Location and Area
  - a. Sub-basins
  - b. Estuaries
- 2. Geology
  - a. Structure (fault, fold, erosional, depositional, etc.)
  - b. Sediments
    - (1) Type (mud, sand, gravel, shell, rock)
    - (2) Depth and distribution
    - (3) Contamination (oil, sewage, heavy metals, toxic substances)
    - (4) Sources and transport processes

3. Physical Oceanography
  - a. Characteristics of currents (patterns and velocities).
  - b. Tides
    - (1) Heights (diurnal/semi-diurnal)
  - c. Fresh water input
  - d. Salinity and temperature profiles (vertical and along estuary axis to limits of salt water intrusion: 5 parts per thousand)
  - e. Characterization of circulation (i.e., Pritchard classifications). Types A, B, C, D
4. Chemical Oceanography
  - a. Through e. as for open continental shelf, #3
    - Pollution sources
      - (1) Locations
      - (2) Quantity and type of pollutant discharged
5. Meteorology/climatology - see discussion under Open Continental Shelf and Regional Overview.
6. Biologic habitats/ecology
  - a. Mussel - Oyster reefs
    - (1) Habitat definition
    - (2) Habitat dynamics
      - Environmental characteristics
      - Microenvironments
      - Nutrient cycles
      - Seasonal cycles
      - Food webs
      - Relative productivity
      - Natural stress
    - (3) Effect of man-induced stress
    - (4) Biological components
      - Zonation (distribution)
      - Annotated checklist of species common to the habitat
    - (5) Habitat distribution
    - (6) Bibliography
  - b. Worm - clam flats
    - (1) Through (6) as above
  - c. Shallow salt pond
    - (1) Through (6) as above
  - d. Salt marshes
    - (1) Through (6) as above

#### Exposed Shorelines

- a. Unconsolidated shores
  - (1) Geology
    - i. Description of morphology and location
    - ii. Grain size characteristics and variations
    - iii. Source of supply of beach materials (drift transport rate and direction)

- iv. Erosion state
- v. Classification of beaches with respect to erosion/deposition and grain size.
- (2) Hydrology
- (3) Meteorology - see Regional Overview
- (4) Biologic Habitats/Ecology
  - i. Sandy beaches
    - (1) through (6) as for mussel-oyster reef
  - ii. Mussel reefs
    - (1) through (6) as above
- b. Consolidated rocky shores
  - (1) Geology
    - i. Description of morphology and location
    - ii. Structure (shallow-quaternary and deeper structure)
    - iii. Methods of obtaining stratigraphic profiles
  - (2) Hydrology
  - (3) Meteorology - see Regional Overview
  - (4) Biologic habitats/ecology
    - i. Rocky shores
      - (1) through (6) as for mussel-oyster reef

B. Transitional and Terrestrial Environments

Shoreland Strand (areas between marine and terrestrial habitats)

- 1. Meteorology
- 2. Geology (bedrock, surficial) - see Regional Overview
- 3. Soil profile, slopes
- 4. Hydrology
- 5. Biologic habitats/ecology
  - a. Definition
  - b. Environmental factors
    - (1) Natural stresses
    - (2) Microenvironments
    - (3) Productivity
    - (4) Vulnerability to man-induced stresses
  - c. Distribution of habitat within coastal watershed area
  - d. General description of major plant-animal associations

Upland Environments (in Coastal Drainage System, including forest associations, freshwater wetlands, lakes and ponds, etc.)

- 1. Meteorology - see Regional Overview
- 2. Geology - surficial and bedrock

3. Soil profile and topography
4. Hydrology
  - a. Delineation of drainage systems
  - b. Definition of aquifers and regional flow patterns
  - c. Depth to water table, upland aquifer outcrops
  - d. Delineation of (100 year) flood zone
5. Biologic habitats/ecology
  - a. through d. as for Shoreland Strand

### III. Plant and Animal Profiles - Life Histories

- A. Phytoplankton
- B. Zooplankton
- C. Macrophytes
- D. Benthic Invertebrates
- E. Fishes
- F. Birds
- G. Mammals

### IV. Unique and Endangered Environments

Areas particularly sensitive to man's activities. Although most coastal and marine environments are, to some extent, endangered by pollution, dredging, construction, etc., some are especially important. Peculiar conditions of currents, topography, temperature, biological activity, etc., can get together to form unique environments such as biologically productive zones for upwelling, bird rookeries and others. Detailed descriptions of these locations will be given including:

1. Name and location
2. Topography - bathymetry
3. Geology
4. Ecology and biology
5. Value to man/ecosystem
6. Nature of vulnerability

### V. Threatened and Endangered Species

Introduction - explanation of following categories:  
threatened, endangered

#### A. Threatened Species

1. Marine
  - a. Name
  - b. Habitat, microenvironment

- c. Population
- d. Nature of threat or vulnerability
- 2. Terrestrial
  - a. through d. as above

- B. Endangered Species
  - same as for Threatened.

## VI. Environmental Quality

- A. Water Quality
- B. Air Quality
- C. Solid Waste Disposal
- D. Ocean Dumping

## Sec. 2.2 Socio-Economic Topics to be Inventoried

### Industrial and Commercial Activity

Data on past and present employment, payrolls, sales, and other relevant measures (and projections of these measures where available) will be tabulated and analyzed for the following industries:

#### A. Resource Industries

1. Agriculture
2. Forestry
3. Fisheries - finfish and shellfish

#### B. Manufacturing

1. Shipbuilding and boatbuilding and repair
2. Pulp and paper
3. Cement
4. Chemicals
5. Other industries

#### C. Service Industries

1. Contract construction
2. Retail trade - restaurants, service stations, stores
3. Wholesale trade
4. Hotels and motels
5. Recreation and amusements
6. Business and financial services
7. Personal and professional services
8. Utilities and transportation
9. Government - federal, state, and local

### Petroleum Industry

The refining and consumption of petroleum would be analyzed in regard to present and potential facilities and the amounts of petroleum produced, transported, and used by class of consumer:

#### A. Production of petroleum products

1. Areas of potential exploration for petroleum or natural gas
2. Capacity and production of existing refineries
3. Proposed refineries - capacities, evaluation of sites

#### B. Consumption of petroleum products

1. Use of petroleum fuels by residential, commercial, industrial, transportation, and miscellaneous consumers
2. Use of petroleum feed stocks by petrochemical plants

#### Demography

Trends and projections of total population would be analyzed, as would census data and other figures on various population characteristics:

##### A. Population

1. Total population - trends and projections
2. Labor force status of population
3. Age and sex of labor force
4. Occupation of employed workers
5. Last occupation of experienced unemployed workers
6. Industry of employed workers

##### B. Income and Employment

1. Sources of personal income by industry
2. Employment and earnings by industry
3. Median earnings of persons in selected occupations
4. Income distribution of families
5. Type of income of families
6. Income of persons below poverty level

##### C. Education and Job Skills

1. Education attainment of labor force
2. Graduates of vocational schools and institutes

#### Land and Water Use

The amounts of land and facilities employed for the following activities would be tabulated and evaluated, maps would be obtained where available, and land use controls would be analyzed:

##### A. Commercial and Industrial Uses

1. Business concentrations
2. Manufacturing
3. Quarries and mines

##### B. Utility Uses

1. Electric power plants

2. Gas systems
3. Water systems
4. Sewer systems

C. Agriculture and Conservation Uses

1. Farms, orchards, and nurseries
2. Pasture and undeveloped areas
3. Forest and wooded areas
4. Wetlands and filled areas

D. Recreation Uses

1. Parks - beaches, picnic areas
2. Boating facilities
3. Resorts
4. Campgrounds
5. Wildlife reserves
6. Scenic areas
7. Archeological sites
8. Historical buildings and sites

E. Residential and Institutional Uses

1. Housing - urban, suburban, scattered rural
2. Schools, other educational, and research facilities
3. Health and correctional institutions
4. Federal facilities - military, Indian, park and other

F. Land Use Controls

1. Federal - Coastal Land Management Act
2. State - planning, zoning, site selection, oil conveyance, wetlands
3. Regional - planning, water, and sewer operation
4. Local - planning, zoning, subdivision, conservation

Pollution Sources

The quantities of air and water pollutants, where measured, would be tabulated from public and private sources and analyzed for each area:

A. Industrial

1. Chemical wastes
2. Animal product wastes

B. Urban

1. Treated domestic sewage
2. Untreated domestic sewage

C. Other sources

1. Waste disposal sites

Transportation Systems

Facilities and usage of the various transportation modes along the coastline would be tabulated, mapped, and analyzed.

A. Petroleum Transportation

1. Piers, anchorages, and storage tanks
2. Inland pipelines
3. Rail and truck facilities

B. Dry Cargo Transportation

1. Harbor facilities - piers, storage, ferries
2. Highways - truck carriers and terminals
3. Railroads - terminals and other facilities
4. Airports

C. Passenger Transportation

1. Highways - automobiles and buses
2. Airlines
3. Railroads
4. Passenger ships and ferries

Sec. 2.3 CEQ Requirements. The Contractor will be required to furnish the following data for the Council on Environmental Quality (CEQ) within the time specified:

A. By August 15: General habitat descriptions for two biogeographic regions. Each biogeographic region (The first is defined from the Bay of Fundy to Cape Cod and the second from Cape Cod to the Southern Boundary of the Contract Area.) can be considered to be an assemblage of various habitats: salt marsh, rocky intertidal, sandy beach, mud flats, estuarine, etc. Within each region, a particular type of habitat can be assumed to be homogeneous. If not homogeneous, the Contractor shall provide supporting data to challenge this assumption, i.e., if species in the Southern part of the region are significantly different than in the Northern part of the same region. These descriptions should be based on key species most likely to be present. Key species are defined as the 5 - 20 species, not necessarily commercial, which makes up 50 - 60% of the total community. Any species

so insignificant as to have little ecological effect on the community as a whole may be excluded, except if a rare and endangered species, commercially important, or having a characteristic of particular importance to the study area. The Contractor is to provide a list of the key species in each habitat. Interrelationships among species and environment should be described. Subtidal benthic habitats should be characterized according to sediment type: rocky, sandy, or muddy. Geographical descriptions should be quantified for either lineal mileage or areal measures and expressed as a percentage of the total region. The source material for these descriptions would be the hydrography as presented in USGS nautical charts. Unique features of a region should be furnished. The map shall be on a scale of 1/250,000, and any habitat of less than one mile along the coastline may be excluded, unless the particular habitat has unique characteristics. These unique characteristics may be defined as being a commercially important oyster bed, a sandy beach involving over \$100,000 in tourist trade, a habitat of a rare and endangered species, or other similar characteristics that would make a habitat of less than one mile long the coastline of particular importance.

B. By October 1: Initial biological description of impact zones, is one in which there is a high likelihood of oil spills. It is expected that the exact zones will be provided to the Contractor before July 15, 1973. It may be assumed that the zones will be along the shorelines with attention paid to possible terminal sites, and within a probable oil spill distance from the drilling sites defined by the points (1) 40°N, 69° 20'W, (2) 40° 30'N, 68° 30'W, and (3) 41°N, 67° 40'W. For each impact zone, a geographical description of the habitats and an identification of unique features within the zone are required. This requires no additional information than the description of the zones, small refinements made by reviewing the Contractor's available data may be required, particularly from the consideration of offshore oil production. Biological information should include fecundity, spawning characteristics, histories data should be provided at this date.

C. By December 1: Complete refinement of data base and provide additional information on life histories of key species. No actual report is required, but working papers only. Communication and cooperation between the BLM Contractor and the CEQ Contractor is expected from award of contract up to the delivery of the working papers on December 1.

# A Bio-Economic and Environmental

